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ABSTRACT

This handbook examines the relationship between school buildings and educational performance. Following the introductory chapter, chapter 2 presents findings from empirical studies that have examined the building/performance issue. Research has demonstrated that the physical setting has both direct and mediated effects on prosocial and achievement outcomes. Chapter 3 presents an ecological model that accounts for physical, psychological, and social environmental factors that affect student outcomes. The fourth chapter offers an analysis based on a review of empirical research, architectural literature, and educational reform literature to inductively develop a set of 27 design patterns. Two patterns based on environment-behavior research are highlighted--small schools and well-defined activity pockets. Chapter 5 discusses implications from the educational reform literature. The complete set of 27 patterns is presented in the sixth chapter. Chapter 7 presents an example that uses patterns to create a prototypical design for a new type of educational facility. The final chapter focuses on the earlier stages of the facility development process, those of feasibility and planning. A reconceptualization of an existing educational facility planning model is offered. A total of 42 figures and 1 table are included. (LMI)

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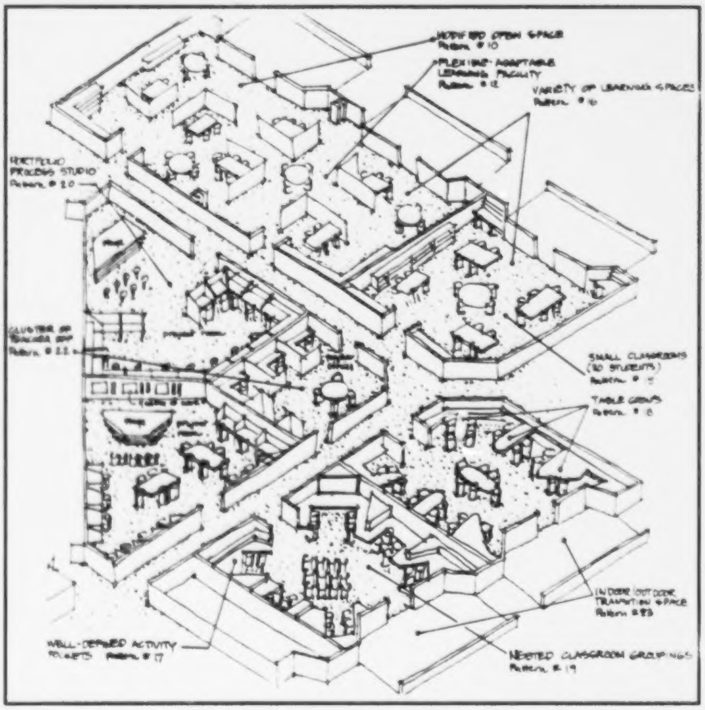
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The School of Architecture and Urban Planning

EDUCATIONAL FACILITIES FOR THE TWENTY-FIRST CENTURY:

RESEARCH ANALYSIS AND DESIGN PATTERNS

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and

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EDUCATIONAL FACILITIES FOR THE TWENTY-FIRST CENTURY: RESEARCH ANALYSIS AND DESIGN PATTERNS

Gary T. Moore and Jeffery A. Lackney

ABSTRACT

There is a crisis in education in the United States and in many other industrialized nations--*and* in the infrastructure of school buildings. This monograph examines in detail empirical studies of the building/performance issue and presents an ecological model to summarize the data and bring some clarity to the issues involved. The heart of the monograph is a process for developing design patterns and a presentation in detail of 27 design patterns developed to respond to the empirical literature and to the educational reform movement that suggest ways in which school buildings can better support educational performance. The monograph illustrates a prototypical design that grows out of the patterns, suggests needed new directions for empirical investigation, and offers a critique and reconceptualization of educational facility planning models. The research behind this monograph has been funded by the Johnson Foundation and Scholastic, Inc., with additional support from the Building Research Board of the National Academy of Sciences. Pp. viii + 90; illustrated.

RELATED PUBLICATIONS

Buildings in Use, by Harvey Rabinowitz, 1975.

Case Studies of Child Play Areas and Child Support Facilities, by Uriel Cohen, Gary T. Moore, & Tim McGinty, 1978.

Recommendations for Child Care Centers, by Gary T. Moore, Carol Gee Lane, Ann B. Hill, Uriel Cohen, & Tim McGinty, third revised edition 1994.

Recommendations for Children's Play Areas, by Uriel Cohen, Ann B. Hill, Carol Gee Lane, Tim McGinty, & Gary T. Moore, 1979.

Children and Museums, by Uriel Cohen & Ruth McMurtry, 1986.

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PREFACE AND ACKNOWLEDGMENTS

Since the mid-1970s the University of Wisconsin-Milwaukee has conducted extensive research on various environments for the developing child.

The earliest research was a post-occupancy evaluation of four school buildings designed by nationally recognized architects in Columbus, Indiana by Prof. Harvey Rabinowitz. A second line of research conducted in the Environment-Behavior Research Institute under the direction of Profs. Gary Moore and Uriel Cohen began in 1976 on outdoor play/learning environments for children with disabilities. That work led to a book, *Designing Environments for Handicapped Children* written with Lani van Ryzin and Jeffrey Oertel and published by Educational Facilities Laboratories. This was followed by a national conference organized by the same group on outdoor play environments that received wide national attention.

In 1978 together with Prof. Tim McGinty, now at the University of Arizona, we spent three years researching child care centers and outdoor recreation for the US Army Corps of Engineers and developed a set of national design guidelines on both child care facilities and associated play areas (from tot lots to regional parks). This work led to a seven-volume report series still available through Publications in Architecture and Urban Planning, two volumes of which, *Recommendations for Child Care Centers* and *Recommendations for Play Areas,* have been reprinted many times (*Child Care Centers* is now in its tenth printing).

Over the intervening years, we have continued to be active in sponsored research and design on a range of children's environments, including children's museums, inner-city recreation areas, group homes for mentally retarded and for emotionally disturbed children, creative, adventure, and comprehensive playgrounds, play facilities in children's hospitals, and playground safety. Our work has included empirical research, demand and location analyses, facility programs, prototypical designs, and design advise to many community organizations, colleges and universities, hospitals, and other private and public sector agencies and groups.

Our work has been supported by the Wisconsin Humanities Committee (National Endowment for the Humanities), US Army Corps of Engineers, National Endowment for the Arts, Graham Foundation for Advanced Studies in the Visual Arts, General Services Administration, Health and Welfare Canada (Child Care Initiatives Fund), and the University of Wisconsin System, both UW-Extension and the School of Architecture and Urban Planning at UW-Milwaukee.

In 1991 the work of the Center branched into another domain critically important to the developing child--elementary and secondary educational facilities. The impetus for this new line of research and research dissemination was a national conference of educators and architects held at Northwestern University and the Crow Island School (designed 50 years ago by Eliel and Eero Saarinen with Wheeler and Perkins, now Perkins and Will) at which Gary Moore was invited to be a workshop leader and panelist.

For the second national conference on Architecture for Education, held at Frank Lloyd Wright's Wingspread and the Prairie School (designed by Taliesen Associates), Gary Moore was commissioned to review and comment on the state-of-the art in educational facilities and to present the results as a keynote address. He invited Jeffery Lackney to help conduct the literature search and prepare the slides used to illustrate the central ideas. We were supported by the Johnson Foundation in this research effort. Inviting Jeff Lackney was not a random event. Jeff is a registered architect and Ph.D. student in environment-behavior studies at UW-Milwaukee. He has had many years of experience as an architect working on educational facilities, and is preparing a dissertation on educational facility planning. Many very thoughtful people were at the Wingspread/Prairie School meeting. To us, the most important was Edward Fiske, the former education editor for the *New York Times* and now an important author on the reform movement in American education. We both learned a tremendous amount from Ted Fiske, both at that meeting and subsequently from his book, *Smart Schools, Smart Kids.* After that meeting, Anne Meek, Assistant Superintendent of the Virginia Beach School System, invited us to prepare a paper on facilities that would support school reform for a book being published by the Association for Supervision and Curriculum Development. We were also invited to prepare a prototypical design for *Agenda*, a Scholastic publication and, subsequently, a comprehensive paper for a special issue of *Children's Environments* on School Design. Meanwhile, Gary Moore was invited to become a member of the Building Research Board of the National Academy of Sciences and to prepare a position paper on the plight of educational facilities in America.

All of this research support gave us the opportunity to work together and to develop our thoughts together. This monograph is the result of that process, and serves as a final report to those various groups and individuals who have supported our work. It is intended to advocate for new ideas in educational facility design, and to disseminate the results of our work to date to the architecture and education profession. We are both most interested to receive your thoughts and criticisms as we continue with the work.

We would like to acknowledge the stimulation and support--financial and intellectual--of many groups and people who contributed to this research. First the organizing committee of the Wingspread/Prairie School Conference, Henry Halsted the Vice President Emeritus of the Johnson Foundation, and Bill Brubaker the Chairman of Perkins and Will for challenging us and funding our work to review of the state-of-the-art of educational facilities (see especially Chapter 2), for giving us a year to do it, and for their encouragement and confidence. The results of that support are represented in the 27 patterns that make up the heart of this work. Ted Fiske for his thoughts, and his writings which have been most influential in helping us understand the reform movement. A one-hour discussion on the topic that for the most part the reform movement is progressing along with

been most influential in helping us understand the reform movement. A one-hour discussion on the topic that for the most part the reform movement is progressing along with no awareness of whether physical facilities matter, while formal architecture blithely moves along oblivious to the reform movement and to current environment-behavior findings, was the single greatest catalyst to our work. The editors of the Association for Supervision and Curriculum Development, *Children's Environments*, and *Rethinking Schools* for their helpful criticisms and editing on draft papers that are chapters in the current monograph. Scholastic, Inc., the publishers of *Agenda* for commissioning the development of the prototypical design that appears as Chapter 7. Andy Lemer, former Director of the National Research Council Building Research Board and Charles Achilles of the Tennessee STAR and LBS Projects for information that is included herein. Finally our colleague Herb Childress for valuable comments on earlier drafts of several of the chapters.

Gary Moore
Jeffery Lackney
September 10, 1993

CHAPTER 1

THE CRISIS IN AMERICAN SCHOOL BUILDINGS[1]

There is a crisis in education in the United States today, *and* in the infrastructure of its school buildings. The nation's school buildings are frail and aging. The public is saying, "It's no surprise that America's public schools are failing." But what is the connection between school buildings and education? Is it one of simply housing children and teachers who will get on with their work independent of the condition or character of the buildings? Or is the connection more intimate--that sound buildings designed in particular ways will aid the goals of education--both academic achievement (bottom-line educational performance[2]) and social-emotional development?

We will examine this issue, first by looking at the infrastructure of US school buildings, and then, in Chapter 2, by examining some of the empirical studies that have looked at the building/performance issue, followed, in Chapter 3, by presenting a model that tries to summarize the data and bring some clarity to the issues involved. We will present in some detail several of some 27 design patterns we have developed that respond to the empirical literature and suggest ways in which our school buildings could better support educational achievement. In conclusion, we will show a prototypical design that grows out of the patterns, and suggest needed new directions for empirical investigation.

School buildings represent an important public asset and a source of major elements of the cost of education. Public recognition is growing that school buildings in many communities across the United States are in poor condition. The ills besetting US educational facilities have been documented widely. A 1989 Washington, DC, study reported in the June 20, 1991 *Washington Post* cited 11,000 fire code violations in 152 schools in the nation's capital alone. The District of Columbia Commission on Public Education (1989) cited fire doors that don't work, classroom doors that don't close, broken toilets, crumbling plaster, potholded playgrounds, and malfunctioning heating systems, among other problems in the learning environment. A study by Maureen Edwards (1991) in Washington, DC, found that educational building conditions are hurting student performance, and estimated that improved facilities could lead to a 5.5% to 11% improvement on standardized tests. A 1988 Carnegie Foundation study found that student attitudes about education are a direct reflection of their learning environment.

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[1] An earlier version of this chapter was written by Gary Moore as part of a position paper for the Building Research Board of the U.S. National Academy of Sciences. Our thanks for the support of the Board. The authors gratefully acknowledge information collected and provided by Dr. Andrew Lemer, Director of the Building Research Board.

[2] There is confusion in the literature about the impacts of design variables on ... what? In an attempt to help clarify the issues involved, we will use a general term *educational outcomes* to include both *academic achievement* (test scores) and *prosocial behaviors* (personality, social, and emotional development, like improved self-concept, what Weinstein [1979] termed "nonachievement behaviors"). We prefer the positive term *prosocial behaviors* or *prosocial development* to the slightly pejorative "non"-achievement behaviors, and will use it throughout this paper. We will, furthermore, use the terms *educational performance* and *academic achievement* as synonymous and interchangeable.

Over 50% of schools in the United States were built in the 1960s with a projected life of 35 years, meaning that over 50% will need major renovation or refurbishing between 1995 and 2000 (Goldberg & Bee, 1991). Many rural schools are even more frail. The Educational Writers Association (1990) suggested that $84 billion in new construction and retrofitting will be required to overhaul the nation's urban school buildings, another $41 billion for maintenance and repair, and $18 billion for rural schools, for a total price tab of approximately $143 billion. Of this amount, a staggering $10 billion was spent on school facilities in 1990 and $10.6 in 1991 (David Walters, Christian Science Monitor, personal communication, May 8, 1991).

There are many prongs to the problem: existing hazardous conditions found in schools throughout the United States; inadequate learning environments to meet new curriculum developments (especially technology changes brought on by the reform movement) and instruction modes; limited community ability or will to finance major maintenance and construction projects; and despite new efforts at year-round schooling, most of the nation's schools being empty for three months each year.

Some commentators, like the Public Education Association (cited in District of Columbia, 1989) and Whittle Communications' Edison Project (Whittle, 1992), have argued for a complete reshaping of the nation's educational system and its schools. The Public Education Association has recently recommended downsizing schools to 500 to 600 pupils per school based on the argument that smaller schools will lead to a more humane educational system. Many commentators decry the amount of time that the nation's schools are closed, arguing to keep schools open year-round and in operation more hours per day. Edward Fiske, in his recent book, *Smart Schools, Smart Kids* (1991), mentions 70 innovative "learning communities" where schools have been integrated with community centers to become centers for child advocacy, health, social, recreation, and housing services.

The urgency of the situation is obvious. Many school districts nation-wide are in an expansion mode and are in planning stages for upgrading facility infrastructure. Demographic projections indicate a continued upswing in K-12 populations over the next 10 years. Since there is no consensus among taxpayers, state departments of public instruction, and local school districts as to what constitutes real needs and how best to address them, improvements are delayed, stop-gap, or attended with large outlays for public relations barrages and top-name facility planners.

Despite these well-documented cases, there is little agreement among teachers, administrators, public officials, or the public at large regarding the significance of these statistics, or even whether school buildings themselves play a fundamental role in educational outcomes. Researchers and educational proponents have asserted that school facilities *are* important to education. There are a number of excellent empirical studies of the explicit relationship between facility characteristics and educational system output (see, for example, the 1990 book, *The Quality of the Physical Environment of the School and the Quality of Education*, edited by Ronald Colven from Sweden, the review by Paul Gump on "School and Classroom Environments" in the 1987 *Handbook of Environmental Psychology*, and recent articles on school buildings by Edward Fiske in the *New York Times)*. In the face of widespread government budget deficits--and while well-documented crises in United States education attract national attention and international amazement--educational facilities typically are ignored or overtly neglected. And thus, some observers say, we just don't know what role school buildings play in educational performance.

There is a crying need for additional studies of the impact of educational facility design on performance, and for excellent dissemination of the results into the educational, facility management, and architectural communities. As a member of the Building Research Board of the National Academy of Sciences, the first of us (GTM) has proposed that the National Academy of Sciences initiate a two-pronged study of educational facilities in the United States. The first prong would be to fully investigate the coast-to-coast magnitude of current problems with the infrastructure of the nation's educational facilities. The second would be to critically review and synthesize the state of knowledge on the impact of school buildings on educational achievement. Following that, those of us in the educational community concerned with the nation's school buildings need to recommend actions that federal agencies, educational associations, facility managers, and architects and engineers can take to alleviate the problems and provide an appropriate infrastructure for the nation's educational needs for the 21st century.

CHAPTER 2

SCHOOL BUILDINGS AND EDUCATIONAL PERFORMANCE[3]

It is often assumed that the quality of educational facilities makes no difference on bottom line academic achievement. Mayor John Norquist of Milwaukee was quoted during debate over a school construction referendum (*The Milwaukee Journal*, October 28, 1992) as saying that there was "no clear relationship between how well kids do in school and the facilities they occupy ... none of this [referring to proposals for school building renovations and expansions] will necessarily improve education." School referendum issues have been defeated across Wisconsin and in many other states. A partial interpretation is that in many cases the public does not believe that improving school buildings themselves will lead to improvements in bottom-line educational performance, i.e., academic achievement scores.

On the contrary, many researchers and educational proponents now assert that school facilities *are* important to education. There are a number of excellent empirical studies of the explicit relationship between facility characteristics and educational outcomes (see, for example, the 1990 book, *The Quality of the Physical Environment of the School and the Quality of Education*, edited by Ronald Colven from Sweden, the review by Paul Gump on "School and classroom environments" in the 1987 *Handbook of Environmental Psychology*, and a series of recent articles on school buildings by Ted Fiske [e.g., 1990] in the *New York Times)*. Looked at empirically, there is now considerable evidence that certain design characteristics like school size, classroom size, location, and the provision of secluded study spaces all make substantial differences in learning outcomes, and, in particular, that school size and classroom size make a difference in academic achievement.

An excellent review of the research on the physical environment of the schools was published by Carol Weinstein in the *Review of Educational Research* (1979). Only part of what Weinstein concluded in 1979, however, is still true: "When classrooms varying in terms of furniture arrangement, aesthetic appeal, and the presence or absence of windows are compared, differences in achievement are nonsignificant. . . . On the other hand, there is considerable evidence that the classroom environment can affect *nonachievement* behaviors and attitudes" (her emphasis, meaning secondary measures of student and teacher attitudes and behavior, like decreased social interaction or increased aggression; we will use the term prosocial behaviors for what Weinstein called "nonachievement behaviors"; see footnote 2).

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[3] This chapter is based in large part on information gathered for a keynote talk given at the Wingspread/Prairie School National Conference on Architecture and Education, Racine, Wisconsin, June 1992. Our thanks for the support of the Johnson Foundation. Thanks also to Charles Achilles for subsequently sending many of his papers and reports on the Tennessee STAR and LBS Projects. This chapter has been published, in condensed form, in *Rethinking Schools* (Moore & Lackney, 1993), and as part of a paper in *Children's Environments* (Moore & Lackney, 1994 in press).

While there is still strong evidence for the effects of school buildings on *pro*social behaviors and attitudes, there is newer evidence that two critical architectural variables directly effect *academic achievement*, and two others may effect academic achievement through mediating attitudes and behaviors.[4]

School Size

Between the early 1960s and 1980, 344 articles were published pertaining to the effects of school size on academic achievement and other achievement-related variables (Garbarino, 1980). Prior to the '60s, many educators and policy makers believed that increasing the size of schools was an important reform idea. This belief led in part to *comprehensive schools* (large campuses from primary to pre-college education) in Great Britain and regional schools in the United States. Larger schools were more cost-effective and believed to be more educationally efficient.

In the now-classic *Big School, Small School*, Barker and Gump (1964) conducted a study of a sample of very big (over 2,000 students) and very small (100-150 student) high schools in Kansas. They concluded, however, that small schools offered students greater opportunities to participate in extracurricular activities and to exercise leadership roles. In particular, participation in school activities, student satisfaction, number of classes taken, community employment, and participation in social organizations were all superior in small schools relative to large schools. A review of some of the subsequent studies appeared in the 1980 *Journal of Youth and Adolescence* (Garbarino, 1980). Small schools (those on the order of 500 students) also have lower incidence of crime levels and less serious student misconduct. Larger schools discourage a sense of responsibility and meaningful participation, particularly among students who have academic difficulty and come from lower socioeconomic backgrounds.

All the above findings relate to design variables other than achievement outcomes (lower incidence of crime levels, less student misconduct, greater participation in extracurricular activities, etc.). In order to differentiate them from bottom-line educational performance, Weinstein termed these and other variables "nonachievement behaviors." The argument presented here is, however, that these prosocial behaviors are better conceptualized as mediating variables which may in turn effect academic achievement, that is that school size effects, for instance, less incidence of student misconduct which will in turn lead to greater performance.

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[4] Many things are not yet known about the relationship between achievement and class size. Perhaps most important is the shape of the curve relating achievement to size. For instance, we know that reductions from 30 to 20 can yield a gain of 6 percentage points, and that another reduction from 20 to 10 may yield another 13 percentage points. But what happens in between? Is the optimal size 10, which would be very expensive, or does the achievement curve flatten out at 15, or even at 18 or closer to 20? And what other variables effect this relationship? Is it the same for all teacher styles, for all school educational philosophies? Changes in pedagogic strategies are crucial too--active learning and participation mean that teachers may need to increase time spent on small-group, hands-on activities. While changing class size effects academic performance, more profound effects would be expected by changing both class size *and* teaching methods.

Other, more recent studies, however, have looked directly at the question of the impact of school size on academic performance. In a report written while at the U.S. Department of Education's Office of Educational Research and Improvement, Fowler (1992) argued that the issue of school size effects at the elementary school level, based upon "the number of students and the general agreement of the findings" (p. 1), is conclusive. In his review, small schools were defined as those between 100-200, with large schools being those in the range 1,500 to 4,000. Examples of the effects of size include: (1) negative relationship between math and verbal ability tests and elementary school size, even controlling for socioeconomic differences (Kiesling, 1967); (2) larger elementary schools being detrimental to student achievement, even holding student income differences constant (Michelson, 1972, cited but not referenced in Fowler, 1992); (3) smaller elementary schools particularly benefitting African-American students' achievement in Philadelphia (Summers & Wolfe, 1977); and (4) negative relationship between school size and student performance being most prevalent in urban schools based on data reported by 4,337 K-6 schools in California (Plecki, 1991, cited in Fowler, 1992; cf. Fowler, 1992 for a number of other corroborating studies).

Classroom Size and Density

Many studies over the past 10 years have looked at classroom size and classroom density and their impacts on educational outcomes. The results, in short, are that high density conditions have been found to lead to increased aggression, decreased social interaction, and non-involvement, all mediating variables. However, small class sizes also lead to better scores on learning achievement tests, as we will now review.

First let's look at some of the "non"-achievement findings. The synthesis report written by Fowler (1992) concluded that attitudes, voluntary participation, *and* achievement all increase in smaller relative to larger classrooms. In classrooms with less students, teachers can have more interactions with each student, can provide a rich and vastly differing array of interactions, can establish learning centers, student learning teams, peer tutors, and other instructional strategies, all of which improves the quality of interactions with each student. These effects may in turn lead to increased educational performance, though we know of no study testing this relationship empirically and directly.

Teacher attitudes also improve as class size is reduced from 30 to 20. Students in small classes participate more than those in large classes (Pate-Bain, Boyd-Zaharias, Fulton, & Wallenhorst, 1992). Student participation in elementary school classrooms is essential for learning to occur. Students were rated in terms of active participation (initiative-taking behavior) versus minimally adequate effort and non-participatory or disruptive behavior. Holding all other things equal, elementary students in the smaller classrooms (like 15:1

classrooms) showed much higher levels of educational participation in school than any other students. Student participation was also linked to staying in school longer.

All of these improvements in teacher attitudes, increased student participation, and increased student-teacher interaction may best be conceptualized, however, as mediating factors. But other studies have looked directly at the impact of class size and density on educational achievement.

Project STAR (Student/Teacher Achievement Ratio Project) was a $12 million, four-year, randomized, longitudinal, experiment in Tennessee involving 79 different schools from 42 state-wide school districts and a consortium of four universities. After selecting the schools for the study, students and teachers were randomly assigned to class types. This was a clear advance methodologically over most previous studies, which were for the most part correlational in nature, not true randomized experiments. As reported in various places (e.g., Achilles, 1992; Finn & Achilles, 1990; cf. Miner, 1992), Project STAR followed some 6,500 children from kindergarten through third grade. Children in smaller classes (13-17 per room) outperformed those in regular-sized classes (22-25 per room) as measured by test scores such as the Stanford Achievement Test. In the early grades, children in smaller classes outperformed children from regular class sizes in all subjects, but especially in reading and mathematics test scores. Smaller classes were especially helpful for children in inner-city schools. And while the improvement was immediately clear in small kindergarten rooms, the benefits increased in first grade and remained stable over second and third grades.

The study demonstrated that students in small classes improved statistically and educationally[5] (average improvements of 15%) on various reading and mathematics achievement measures in comparison with students in regular classes and in comparison with regular classes with the added benefit of full-time teacher aides. This finding was consistent at each grade level (K-3) and across all locations--rural, urban, suburban, and inner city (Nye, Achilles, Zaharias, Fulton, & Wallenhorst, 1992a, 1992b).

A follow-up study using the same schools, pupils, and tests, called the Lasting Benefits Study (LBS), has been looking to see if there are any long-term effects of small class size (e.g., Achilles, 1992). What happens for students who benefited from small class sizes during the K-3 years when they return to larger classrooms (25:1) in grade 4? The LBS analysis yielded clear and consistent results across 4,500 of the students able to be tracked from the earlier STAR study. Students previously in small classrooms demonstrated statistically significant advantages two years later over students previously in regular size classrooms and even those with an extra teacher's aid. Performance gains ranged from 11-34%. The results were consistent across rural, urban, suburban, and inner city schools. The greatest achievement advances appear to be for inner-city and suburban classes, and for minority students.

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[5] The distinction here is that many findings reported in the literature may be statistically significant at, say, even the .001 level, but may not mean much educationally. The raw magnitude of differences between, say, experimental and control groups may be marginal. The findings from the Project STAR study, however, are not only statistically significant but also of great significance educationally.

These findings are corroborated by other independent studies which have shown that smaller class sizes can lead to greater mathematics achievement (Bourke, 1986).

These and the Project STAR results are buttressed by studies from other states and Canada. In an initiative called Prime Time, Indiana reduced some K-2 classes from an average of 23 students for each teacher in 1981 to 14 to 18 per teacher in 1983 (Howley, 1989). The results were impressive, with 14% more students in the small classes scoring above average on standardized reading and mathematics achievement tests than student from larger classes. These findings were consistent for the United States and for Canada, as found by Shapson and colleagues in a large-scale randomized experiment conducted in Toronto in the late 1970s (Shapson, Wright, Eason, & Fitzgerald, 1980).

A meta-analysis[6] of previous studies on the effects of class size was conducted in 1982 by Glass, Cahen, Smith, and Filby in *School Class Size: Research and Policy*. Meta-analyses were performed on only those studies from the research literature that met criteria for investigative design and control. A recent chapter by Gump (1987) has concluded that the studies included in the meta-analysis by Glass and his colleagues are the methodologically best in the literature. The authors concluded, without qualification, that "reduced class-size can be expected to produce increased academic achievement" (p. iv). Though now eleven years old, this meta-analysis across a wide range of studies indicated that reducing class size from 30 to 20 can yield a gain of 6 percentage points on various standardized reading and mathematics achievement tests, whereas a reduction from 20 to 10 students per classroom yields *another* 13 percentage points in achievement. Reductions in class size begin to make substantial differences in academic achievement around 15 students to a class.

Many things are not yet known about achievement as a function of small sized classrooms. Perhaps most important is the shape of the curve relating achievement to size. We know that reductions from 30 to 20 have yielded a gain of 6 percentage points, and that another reduction from 20 to 10 yielded another astonishing 13 percentage points. But what happens in between? Is the optimal size 10, which would be very expensive, or does the achievement curve flatten out at 15, or at 18, or closer to 20? And what other variables effect this relationship? Is it the same for all socio-economic levels? for all teacher styles? for all educational philosophies?

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[6] For clear definitions, discussion, and examples of meta-analyses in environment-behavior studies, see Gifford, Hine, and Veitch (in press).

Location and Noise

Other physical planning and design variables may also effect important mediating variables. For instance, the location of new schools is now known to be important. A series of studies in the United States between 1980 and 1986 reviewed by Gary Evans and his colleagues (Evans, Kliewer, & Martin, 1991) in *New Directions in Health Psychology Assessment* concluded there are significant increases in blood pressure associated with schools being near noisy urban streets. Other findings related to location include German and Russian studies (Berglund & Lindvall, 1986, cited in Evans et al., 1991) again indicating increased systolic and diastolic blood pressure in middle-school children in schools close to noisy urban streets and abnormally high blood pressure in children residing around Soviet airports. Exposure to traffic noise at elementary schools also has been associated with deficits in mental concentration, making more errors on difficult tasks, and greater likelihood of giving up on tasks before the time allocated has expired. Furthermore, as found by Cohen, Evans, Stokols, and Krantz (1986) in Los Angeles, elevated blood pressure does not habituate or decline with continued noise exposure over time--children don't get used to noise.

While blood pressure, concentration, and task persistence are neither academic achievement nor prosocial outcomes, they are important mediators of educational outcomes. The appropriate location of new schools and their proper design should be able to alleviate these noise-related problems.

Secluded Study Spaces

Secluded study spaces within classrooms are also important to student development, and have been found empirically to be related to various educational outcome measures. Creating small learning centers within classrooms reduces classroom visual and auditory interruptions, makes learning materials more accessible, increases privacy, and leads to more questions asked by students. A study some time ago in the 1982 *Elementary School Journal* (Morrow & Weinstein, 1982) reported that structured reading areas significantly increase literature use by students.

Research conducted out of our Center has discovered that for preschool children, architecturally well-defined behavior settings (in contrast with partially defined and poorly articulated settings) contribute to significantly greater degree of engagement with learning activities, longer attention span, more teacher involvement with children, less teacher interruptions, and more exploratory behavior, social interaction, and cooperative behaviors among the children (Moore, 1986).

Again these "outcomes" may best be conceptualized as mediating factors which in turn would be expected to influence more bottom-line educational performance (minimizing disruptions and helping to increase attention span through appropriate architectural design would be expected to lead to higher academic achievement).

So, are Educational Outcomes Affected by Architectural Design?

We mention these areas of research because in the policy community, at least in the United States, there is a widespread--but quite mistaken--impression that there is no relationship between how well children do in school and the school buildings they occupy. To the contrary, there now is considerable evidence reported in the past 15 years that school size and classroom size directly lead to significant and substantial differences in learning achievement, and that location and the provision of secluded study areas within classrooms effect various beneficial mediating factors (like more student-teacher interaction, less interruptions, and greater student participation in learning) which there is good reason to believe will in turn lead to higher educational achievement.[7]

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[7] Other pathogenic factors are critical not only to performance but to the overall physical health of children. Children in 20% of new preschools built in the Stockholm area since 1975 have been effected by the *sick building syndrome*, showing clear signs of sensory irritation, skin rashes, and mental fatigue due to the tightening of those buildings for energy conservation purposes (Berglund & Lindvall, 1986, cited in Evans et al., 1991).

CHAPTER 3

AN ECOLOGICAL MODEL OF PHYSICAL, PSYCHOLOGICAL, AND SOCIAL ENVIRONMENTAL FACTORS AFFECTING EDUCATIONAL OUTCOMES[8]

Possible impacts of the physical setting on the quality of education is an important issue which has not been adequately addressed by either the educational or architectural professions. What impact and role does the physical school environment have in affecting learning outcomes? The conclusion from Chapter 2 is that the physical setting, in addition to more familiar psychological and social variables, has both direct and mediated affects on prosocial and achievement outcomes, the conventional bottom-line quantitative measures of educational performance.

Historically, concern for the physical environment of the school has been limited to the enforcement of minimum standards for classroom size, acoustics, lighting and heating--the actual physical conditions of the school building itself. The assumption has been that as long as these basic requirements are met, the child's learning depends in large part on pedagogical, psychological and social variables (Weinstein, 1979). The role of the physical environment as a *variable* influencing learning outcomes has not been investigated extensively in the educational research literature. This second, more dynamic way of viewing buildings, as part of an interrelated component of a larger learning environment system, has rarely been addressed in the research literature.

In order to understand the current debate over the role of the physical setting on learning it is necessary to look at the school reform movements of the 1950s and 1960's; the origins of this debate. The open education movement of the 1960s is largely credited for the increase in awareness of the impact of the physical environment on student behavior and attitudes. Architects designing new schools took a mistakenly too literal interpretation of the *open education* philosophy by creating *open plan* or *open space* schools. The rationale most commonly cited for these radical changes in design was economics, however it is obvious design was being driven by a new philosophy in education.

Much of what is known about the physical environment of the school is a direct result of research conducted under the auspices of the Educational Facilities Laboratories (EFL) established in 1965 and funded by the Ford Foundation. With the dissolution of EFL in the middle 1970s, research on the physical environment of the school has declined considerably.

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[8] An earlier version of this chapter was presented as an unpublished seminar paper by Jeffery A. Lackney entitled "The impact and role of the physical setting of the school on learning outcomes: A case study of the Milwaukee Public Schools Facilities Master Plan," School of Education, University of Wisconsin-Milwaukee, December 1992. For general discussion of interactional models in child-environment research, see Moore (1989). A further explication of the model will be given in a companion paper (in preparation).

The net results of the empirical evidence generated during the open classroom experiments concerning the impact of the physical setting on learning have been mixed. Physical features which have been researched include such variables as seating position, classroom arrangement, open versus traditional classrooms, class density, noise, windowlessness and lighting. Where these features of the physical setting have been examined for causal linkages to student achievement there has been only partial empirical support. However, there is considerable evidence that the physical setting directly effects both teacher and student behavior and attitudes. It can be further argued that the impact of the physical environment on the behavior and attitudes of teachers and students has a mediating effect on student achievement, an effect generally unappreciated by both researchers and educational policy makers.

As reviewed in Chapter 2, there is compelling evidence, such as in the case of class size and school size, that the physical setting impacts directly on academic achievement. Other physical variables such as location and the provision of secluded study spaces impact less directly by effecting blood pressure and student attention spans. These type of variables can be best conceptualized as intervening, or mediating variables (physiological and behavioral, respectively). In terms of explanation, it is not surprising--in the case of location and secluded study space variables--that regular, rather than elevated, blood pressures and increased attention spans will lead to higher achievement outcomes.

These and the other substantive findings reviewed in Chapter 2 suggest the need to develop a more comprehensive model of the factors contributing to learning achievement. The model presented in the chapter reconceptualizes the effects of the physical environment of the school on performance outcomes in light of the more familiar psychological, social and pedagogical factors more often considered by educational researchers.

Making Sense of the Evidence: The Need for an Ecological Model of Physical, Psychological, and Social Environmental Factors Effecting Educational Outcomes

What all of this seems to suggest (direct impacts of environment on behavior, possibilities of mediating effects, etc.) is the need to develop a more comprehensive model of the factors contributing to learning achievement outcomes, including explicit physical environment factors in addition to the more traditional psychological, social and pedagogical factors. Much of the empirical research to date has failed to look comprehensively at the wide range of factors which collectively effect educational outcomes. This lack of direction on the part of the research community has resulted in mixed, contradictory results and has contributed to the decline of interest in this area of research. However, the findings indicate that critical mediating relationships have gone unnoticed, or at least have been ignored in favor of more immediately promising research.

This chapter presents a model of theoretical relationships which attempts to clarify and reconceptualize the empirical research conducted thus far. Such a model would explicitly include not only a range of psycho-social and pedagogical factors, but physical environmental factors as well. Such a mediational-interactional model is proposed in Figure 3.1. This model reconceptualizes the effects of the physical environment of the school on performance outcomes. The mediational-interactional model summarizing theoretical linkages between (a) *independent factors:* physical environment factors (e.g., class size, school size, etc.) and the social-organizational environment (e.g., teaching practices, classroom management); (b) *mediational factors:* behavioral (e.g., student-teacher interaction) and attitudinal (e.g., teacher morale), and physiological (e.g., blood pressure); and (c) *educational outcomes:* achievement (e.g., mathematics achievement scores and Stanford Achievement Test) and prosocial behavioral outcomes (e.g., improved self-concept).

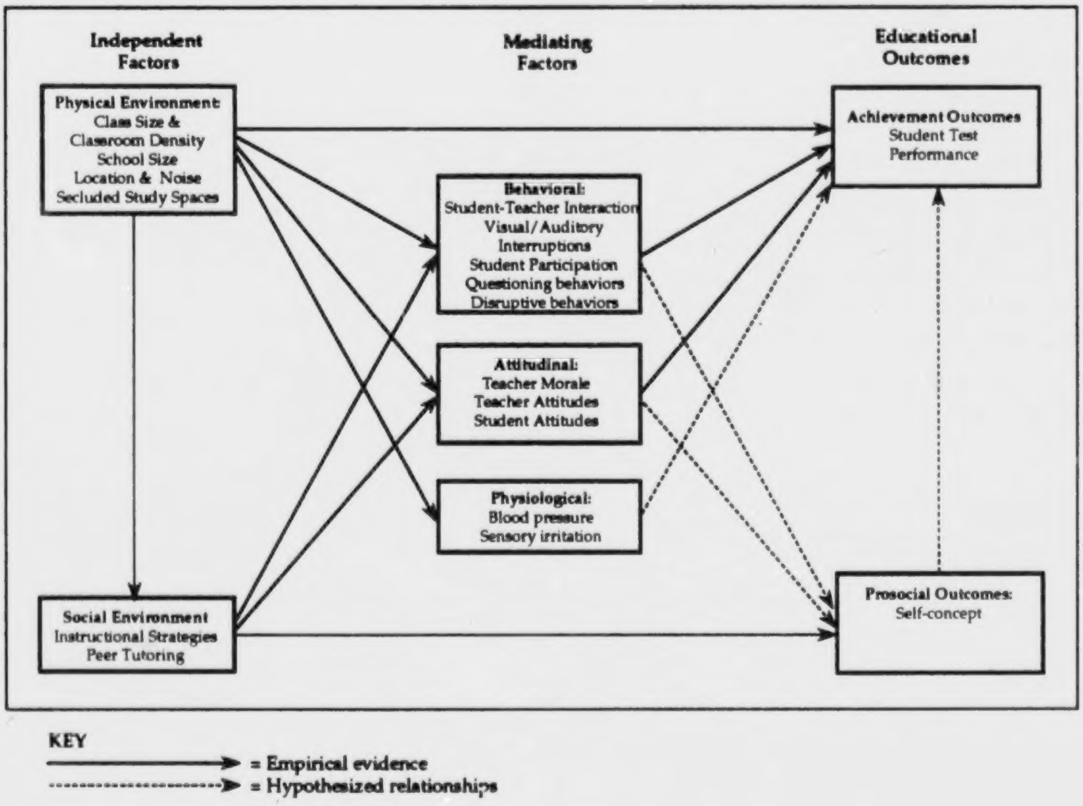
Independent Factors
Mediating Factors
Educational Outcomes
Physical Environment: Class Size & Classroom Density School Size Location & Noise Secluded Study Spaces
Behavioral: Student-Teacher Interaction Visual/Auditory Interruptions Student Participation Questioning behaviors Disruptive behaviors
Attitudinal: Teacher Morale Teacher Attitudes Student Attitudes
Physiological: Blood pressure Sensory irritation
Achievement Outcomes Student Test Performance
Prosocial Outcomes: Self-concept
Social Environment Instructional Strategies Peer Tutoring
KEY
= Empirical evidence
= Hypothesized relationships

Figure 3.1. A mediational-interactional model of environmental factors affecting educational outcomes.

The data in the educational research literature (e.g., Weinstein, 1979) and reviewed above indicates--and this model summarizes--that physical environmental factors, such as class size and school size, affect academic achievement directly, through mediational factors like influencing teaching practices, and via prosocial outcomes.

The model hypothesizes that as the physical setting of the school improves (e.g., through decreased class sizes and smaller schools), teacher and student behavior and attitudes will improve, and increases in achievement and prosocial outcomes will be further realized. In addition, the model hypothesizes that the physical environment factors affect educational outcomes by affecting teaching practices which impact achievement outcomes through mediating factors, as well as directly affecting prosocial outcomes. In short, the model illustrates both the direct and the indirect/mediated yet consequential effect of the physical environment on achievement outcomes. It may be that with a more comprehensive model, one which includes all potential factors of influence on achievement, the debate over the impact of the physical setting on learning will be clarified and resolved.

The model, shown in Figure 3.1, differentiates between those theoretical relationships which have empirical evidence and those which are as yet hypothesized relationships. The relationships between particular independent factors and specific mediating factors have been firmly established through the weight of the past 30 years of empirical support. The relationships between mediating factors and educational outcomes have not been adequately investigated. Does increased student participation lead to higher student performance? Does improved teacher morale and attitudes lead to an increase in students' self-concepts? These are the types of areas of research educational researchers must focus on if a positive link between physical environmental factors is to be empirically supported.

Additional studies are needed on the impact of educational facility design on performance, and for excellent dissemination of the results in the form of design patterns and in other ways into the educational, facility management, and architectural communities. As a member of the Building Research Board of the National Academy of Sciences, the first of us (GTM) has proposed that the National Academy of Sciences initiate a two-pronged study of educational facilities in the United States. The first prong would be to fully investigate the coast-to-coast magnitude of current problems with the infrastructure of the nation's educational facilities. The second would be to critically review and synthesize the state of knowledge on the impact of school buildings on educational achievement. Those in the educational community concerned with the nation's school buildings need to recommend actions that federal agencies, educational associations, facility managers, and architects and engineers can take to alleviate the problems and provide an appropriate infrastructure for the nation's educational needs for the 21st century.

Conclusions

Even with the weight of empirical evidence presented here and elsewhere (see particularly Fowler, 1992; Garbarino, 1980; Weinstein, 1979), the extent to which the physical environment plays a role in the learning process remains an issue of contention within the educational community. Should school facilities simply continue to be held to minimum standards, or is there a linkage between educational programs and the physical setting which would suggest a more comprehensive approach?

It is clear that the physical environment has been unappreciated for its potentially supportive role in student learning. The relationships between the physical environment, pedagogical, psychological and social factors have yet to be explored to any great extent by educational, child development, or environment-behavior (EB) researchers. If the physical environment is more influential than realized, as suggested by the evidence presented on class size and school size, as well as student and teacher attitudes and behavior, it will be incumbent upon educators to take another to take another look--a more holistic, ecological look--at the whole range of factors and their interrelationships upon which the child's learning depends.

CHAPTER 4

GIVING FORM TO EMERGING EDUCATIONAL CONCEPTS: RESPONDING TO THE ENVIRONMENT-BEHAVIOR LITERATURE[9]

School districts and school boards across the United States are debating the merits of improving the infrastructure of schools in their districts. Should money be spent on rehabilitating turn-of-the-century buildings and on deferred maintenance? Or should money be spent on new facilities? If school buildings are renovated, or new ones built, can they be more responsive to new ideas in education? Can they aid improvement of instruction and the improvement of academic performance?

In the June 1992 *AASA Leadership News*, the first of us (GTM) was quoted as saying "... school designers and planners can give form to emerging educational concepts." The quote was accurate and correct. We would now like to expand on this view. There are, as the article continued, "... a number of ways ..." in which architects and other designers can give form to emerging educational concepts.

Patterns and Design Guidelines

We see two different ways to approach this issue: the development of patterns[10] and design guidelines based either on the translation of empirical research (the subject of this chapter) or on extrapolations from educational reform ideas in combination with the practical experience of educators (the subject of the next chapter).

The first way is to "translate" findings from the empirical research literature on the effects of school buildings on educational performance into research-based design guidelines, patterns, or design principles (all of which will be taken here to be roughly equivalent), and then work to implement those design guidelines in new and renovated school building projects. This is an inductive, inferential, inherently creative process, and is the subject of this chapter.

The second, and still acceptable way--if it is done with humility and caution--is to extrapolate from educational reform ideas and the experience of reflective educators in order to give these ideas architectural form. What we mean by this is to take an educational idea--like the notion of site-based management--and ask what characteristics, if any, of buildings *might* assist in achieving this idea. Assuming for the moment that it is a good idea, what characteristics of the physical, designed environment of the school might make it easier to achieve the idea of site-based management? It's like setting a stage for a play. The stage won't guarantee that the play will be a critical success, but it very likely will help; it will likely increase the probability of success. In the absence of conclusive empirical evidence, we cannot say such inductive architectural principles *will* for sure improve performance, only that they *might.* Thus this second way of giving form to emerging educational concepts is also very much an inductive process resulting also in working hypotheses. It is the subject of the Chapter 5.

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[9] This chapter is based on parts of a keynote talk given at the Wingspread/Prairie School National Conference on Architecture and Education, Racine, Wisconsin, June 1992.

[10] The notion of design patterns is based on the work of Christopher Alexander and his colleagues (Alexander, Ishikawa, & Silverstein, 1977). A *pattern* is a structural configuration, the core of the solution to a problem that occurs over and over again in the environment. As Alexander et al. say, it "describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice" (p. x).

In either case--translation of research or extrapolations from educational reform and reflective practitioner's experience--the important kernel, the structural core of the idea, can be called a *pattern.* We have been involved in developing a set of design patterns that translate existing empirical data into architectural form, and, where there is no empirical data yet, interpreting educational reform ideas and creating working hypotheses about other aspects of architectural form. Scientifically, the patterns are working hypotheses, subject to further scrutiny, documentation, and, most especially scientific test through attempted falsifications.[11]

The General Method for Developing Patterns

Our approach in this and previous work,[12] has been, first, to review empirical literature identifying reliable findings about the impacts of the designed environment on educational performance (e.g., teacher attitudes, student attitudes and behavior, and student achievement). The educational and environment-behavior (EB) research literatures have over the years dealt with the concerns of the physical environment and its relationship to educational program effectiveness.

For example, as discussed in some detail earlier, an excellent review of the research on the physical environment of the schools was published by Carol Weinstein in the 1979 *Review of Educational Research.* As shown above, however, only part of what Weinstein concluded in 1979, however, is still true: "When classrooms varying in terms of furniture arrangement, aesthetic appeal, and the presence or absence of windows are compared, differences in achievement are nonsignificant.... On the other hand, there is considerable evidence that the classroom environment can affect *nonachievement* behaviors and attitudes" (her emphasis, meaning secondary measures of student and teacher attitudes and behavior, like decreased social interaction or increased aggression). While there is still strong evidence for the effects of school buildings on nonachievement behaviors and attitudes, there is newer and what we would call incontrovertible evidence that at least four critical architectural variables directly and indirectly effect educational achievement.[13] Several areas of research continue to be productive, such as the impacts of classroom size and overall school size on performance (e.g., the Tennessee STAR study), while new research has emerged on the importance of the spatial definition of activity spaces. But there are a myriad of other topics and issues dealing with the physical environment of the school which are not being addressed by the educational or EB literatures.

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[11] For an example of how to test patterns scientifically through quasi-experimental research methods, see Moore (1986).

[12] The reader is referred to the series of monographs, technical manuals, and papers on child care listed in *Publications in Architecture and Urban Planning Research* and in "Publications and Papers on Children and the Designed Environment" available from the UW-Milwaukee Center for Architecture and Urban Planning Research.

Second, the architectural literature was reviewed and analyzed,[14] looking at a range of educational facilities. A total of 100 school buildings from the US, Canada, England, and elsewhere in Europe were included in the analysis. These were the best examples of award-winning school designs in the 1980s and early 1990s. A wide variety of formal architectural designs and ideas emerged, which have been tried over and over again in different locations, and seem to have passed the test of time.

This type of analysis could be construed as subjective and biased by prevailing trends. The experience of design inquiry by successful architectural practitioners should not be so quickly dismissed. From the collective experience gained by designing educational facilities, architects and school administrators have found that certain architectural design patterns work better educationally than others. But for the purposes of this chapter, the rationale for searching and collecting design examples from the architectural literature was to find particular building designs that can serve to exemplify the patterns derived from the interpretation and translation of the empirical literature.

Numerous school buildings have been published in the architectural press, but with infrequent critical commentary. Many buildings appear to exhibit friendly and non-institutional designs. For instance, the massing has been broken down into residential building--scaled forms, with sloped roofs, open and operable windows, and intimate spaces inside. In some cases, corridors have become indoor "streets" for incidental socializing and unstructured teaching. But the commentaries in the architectural press, where they exist at all, address only the uniqueness of the design of these schools, and whether the design evokes picturesque or excessively post-modern images (such as polychromatic brickwork, intricate stucco details, bell and clock towers, etc.), not whether they lead to better teaching/learning environments for the users nor whether they have any impact on educational performance.[15] In addition, there has been no empirical literature on the myriad of other design decisions which a responsible architect has to make in the course of designing, renovating, or expanding a school building.

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[13] For another review of the evidence, see "Blueprints for school success" in *Rethinking Schools* (Moore & Lackney, 1993). See also Chapter 2.

[14] Though this chapter focuses on responding to the EB literature, the process of deriving the patterns is generic, and is presented here. For case study examples of working with other than the empirical EB literature, e.g., the educational reform literature, please see Chapter 5.

In addition, third, we studied some of the educational reform literature. Our analysis here was looking for possible implications for the design of educational facilities. Questions raised by this analysis included: How will shared decision-making impact facility layout of classrooms or whole school buildings? What is the implication of new forms of assessment, such as portfolios, on the use of classroom space? How will the process of furthering the professionalization of the teaching profession impact the privacy needs of teachers? The relationship between school design and educational reform is only beginning to be addressed. Several patterns identified here are based on the ground-breaking work of the California Department of Education in their 1990 publication *Schools for the Twenty-first Century*, and the work of the Architectural League of New York and their 1992 publication *New Schools for New York: Plans and Precedents for Small Schools.*

Fourth, communalities between these literatures were examined by asking the questions: Were findings from the empirical literature reflected in any of the recent design trends? Is there empirical support for some of the educational reform ideas? It was found that, on whole, none of the architectural publications made any reference to scientific findings and none of the empirical studies cited particular buildings. Few of the architectural presentations referred to any type of assessment of facilities (with the exception of the British *Architect's Journal* and *Architectural Review).* However, some communalities were noted. For example, the findings on the limitations of open plan schools and the research reported from our own labs on "modified open plan schools" is directly related to the architectural trend toward suites of classrooms and the pod school.

Fifth, following this process, a set of 27 design patterns were inductively created from the analysis of communalities in the literatures. The following Chapters 5, 6, and 7 expand on these steps: Chapter 5 shows implications especially from the educational reform literature, Chapter 6 the full set of 27 patterns, and Chapter 7 an example of using the patters to create a prototypical design for a new type of educational facility.

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[15] A recent example was at the architectural jury presentation and exhibit of school architecture cosponsored by the American Institute of Architects at the American Association of School Administrators 1993 conference in Orlando. In answer to a question, the chair of the jury remarked that none of the approximately 100 submissions broke new conceptual or educational ground. None reported any connection to the educational research, environment-behavior, or educational reform literatures.

Patterns for Schools and School Design

We have developed a set of the most important patterns for schools and school design.[16] Each of our *patterns* is a design principle that may shape the form of the future design of schools. They are organized into four clusters, or four levels of hierarchy:

1. Planning Principles
2. Building Organizing Principles
3. The Character of Individual Spaces
4. Critical Technical Details

To date we have generated 27 patterns,[17] of which two will be presented in some detail in the current chapter (but see also the review of critical environment-behavior evidence in Chapter 2 above): And the Winning School is ... Smaller, and Well-Defined Activity Pockets.

Case Study: Two Patterns based on Environment-Behavior Research

In this chapter, as a case study of the above process and of the value of interpreting and translating EB research literature, we will present two of the patterns in some detail as examples. These patterns are based on the empirical EB evidence reviewed in Chapter 2, one directly linked to academic achievement and the second linked to expected achievements through mediating prosocial behaviors.[18]

And the Winning School is ... Smaller

One of the first issues school Boards, administrators, educational facility planners, and other educational leaders must address in educational facility planning is the optimal overall size of a school.

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[16] While some of our patterns not discussed in this paper, like Building Core or Great Spaces, have been influenced by Brubaker's "These 21 trends will shape the future of school design" (1988), our set of patterns is based on inductive translations of existing empirical research and thus is not the same as Brubaker's set of trends.

[17] This list is by no means exhaustive. We hope that as a result of the publication of this brief paper we can generate some discussion that will help us to refine the list, combine or delete redundant patterns, and develop needed new ones.

[18] The next chapter, "Design patterns for American Schools: Responding to the reform movement," examines seven patterns based largely on the reform movement (e.g., Fiske, 1991).

The Public Education Association, as mentioned earlier, has argued for downsizing schools to 500 to 600 pupils per school. The argument goes that smaller is better, that smaller schools will lead to a more humane educational system.

And, as reviewed above, the environment-behavior evidence is that in comparison to large schools (over 1000 students), small (400-500 students) and medium-sized schools (900-1000 students) have better educational records. More students are involved in governing decisions. All other things held equal, there is less crime. There is more sense of responsibility. Discipline is higher. Less misconduct is found after schools subdivide 3,000 students into a number of smaller schools. Large schools undermine character development and socialization to adulthood by not providing a full range of participatory activities. Conversely, students in smaller and medium-sized schools take more part in extra-curricular activities, there is more overlapping of roles, they are more satisfied with the participation, and overall they have more positive self concepts.

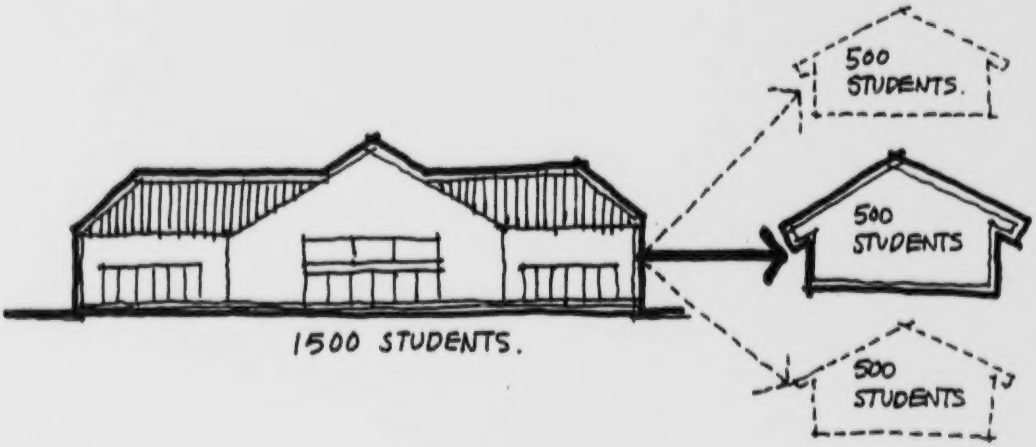

Figure 4.1. And the winning school is ... smaller.

As Paul Goldberger's review of the design competition on "New Schools for New York" concluded (see also Genevro, 1990; Rieselbach, 1990), "Educators have begun to suggest that the real sin in contemporary school design is size ... and the winning school is ... smaller" (Goldberger, *New York Times*, May 27, 1990).

The pattern is creating schools of approximately 500 students, or subdividing larger schools (1,500 or more) into a campus-plan or clustered-plan of semi-autonomous modules of 500 students each.

Well-Defined Activity Pockets

Concordant with the notion of smaller, more personal schools is the architectural definition of areas within the schools and within "classroom."

Research conducted at our Center has discovered that architecturally well-defined behavior settings (in contrast with partially and poorly articulated settings) contribute to significantly greater degree of engagement with learning activities, more teacher involvement with children, less teacher interruptions, and more exploratory behavior, social interaction, and cooperative behaviors among the children (Moore, 1986). Other research on classroom design has found that smaller clusters lead to increased use of learning materials (Weinstein, 1982), to increased substantive, content questions (Evans & Lovell, 1979), less non-task-oriented movement, less loud conversations, longer attention spans, and overall greater satisfaction.

As reviewed earlier, sound absorbing partitions used to create Well-defined Activity Pockets redirect traffic, demarcate class boundaries, and create small areas for privacy, all of which presumably will lead to increased achievement measured by standardized educational tests.

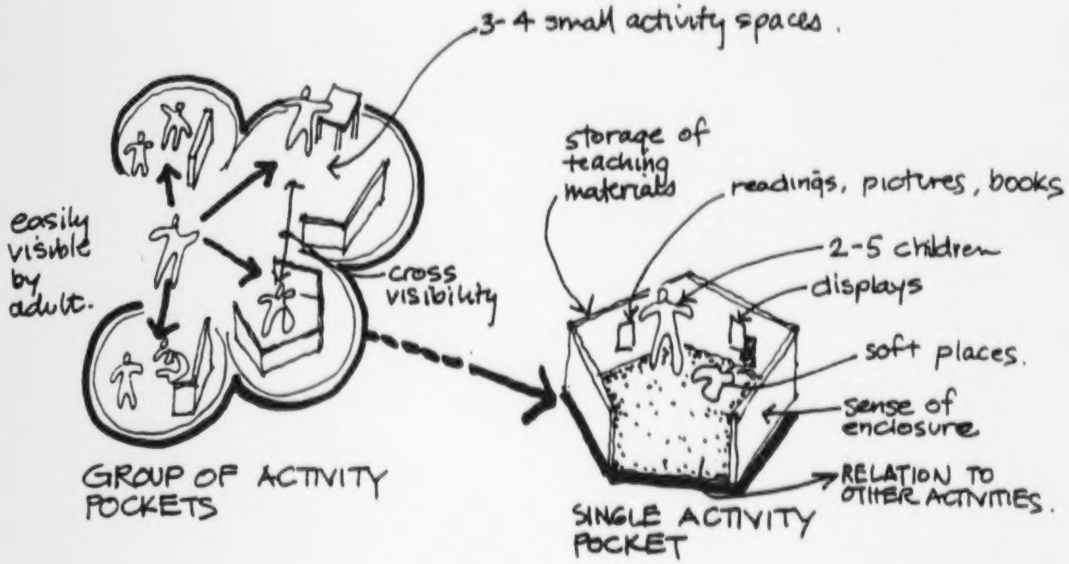
3-4 small activity spaces.
storage of teaching materials
readings, pictures, books
easily visible by adult.
2-5 children
cross visibility
displays
soft places.
sense of enclosure
RELATION TO OTHER ACTIVITIES.
GROUP OF ACTIVITY POCKETS
SINGLE ACTIVITY POCKET

Figure 4.2. Well-defined activity pockets.

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Well-defined Activity Pockets is a clear environment-behavior issue with considerably supporting research that many designers have picked up on with lecture pits, lofts, well-articulated activity nooks, and various other measures to isolate noise, dirt, and congestion from the primary learning centers. We have even recently found an early and influential educational facilities design book, *Planning Flexible Learning Places,* published in 1977 (Leggett, Brubaker, Cohodes, & Shapiro, 1977) which, though not based on empirical research, advocated giving students architecturally well-defined "turf" for small-group learning activities.

In both of these patterns, as in the other ideas emerging from the empirical EB research literature and from the educational reform movement, school designers and planners *who are familiar with the research literature and sensitive to the needs of children* **can** give form to emerging research and educational concepts.

CHAPTER 5

DESIGN PATTERNS FOR AMERICAN SCHOOLS: RESPONDING TO THE REFORM MOVEMENT[19]

This chapter explores the often elusive yet critically important relationship between architectural design and educational reform. A review of the major ideas in the educational reform literature--especially those which seem to have architectural implications--has led to a set of design *patterns* which we would argue respond to the reform movement.

Case Study: Five Educational Reform-Based Patterns

The process of generating these patterns has been discussed in Chapter 4. We will now focus on implications of the educational reform movement by presenting five sample design patterns which respond primarily to current American educational reform ideas: School as a Community Center / Necklace of Community Activities; Team Suites / Clusters of Classrooms; Supervisable Circulation Paths; Portfolio Process Studio; and Cluster of Teacher Offices.

School as a Community Center / Necklace of Community Activities

Educational reform commentators have suggested that one of the important new educational directions for the 21st century school is integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and making the school a hub for community activities. This pattern is in response to a wish for a broadening and deepening sense of community--to the school as a life-long learning community. As an example, in *Smart Schools, Smart Kids,* Ted Fiske discussed a number of innovative learning communities, centers for child advocacy, and some 70 community organizations dealing with health, social services, recreation, and housing. The *American School Board Journal* of May 1990 reported that the construction of community recreation centers as part of schools has contributed to community support for public education among a growing number of community residents. Centers are scheduled so everyone in the community can use them, adult education programs, senior citizen groups. etc. New schools now include child care centers, the best examples being in Ontario, job training educational programs, youth programs, programs for parents and families, social services, and facilities for community and town hall meetings.

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[19] An earlier version of this chapter was given as part of the introduction to a keynote talk at the Wingspread/Prairie School National Conference on Architecture and Education, Racine, Wisconsin, June 1992. It will be published in A. Meek (Ed.), *Architecture and Learning* (Moore & Lackney, in press). Our thanks to Anne Meek for inviting the chapter, and to Ted Fiske for suggesting the idea of plumbing the educational reform literature for ideas which could be translated into patterns. His most recent book, *Smart Schools, Smart Kids,* has been most instructive in this regard.

Architecturally, the school may either wrap around the community functions as around a "town square," or the community functions may be a "necklace" around the school. An example of the former is the Lago Lindo School in Edmonton (*Canadian Architect*, 1991), in which a simple urban piazza connects the school to a future community building, creating a focal point for the community. The piazza, a major gathering spot for the school, has also become a focal point for the community. It is only a short step from the school as a community hub to using the school year round, both for primary education and for community functions. An example of the latter is the Desert View Elementary School (reported in *Architecture*, 1989) where a multipurpose pavilion and cafeteria is shared by the community and is oriented towards a public entry plaza. In both cases, the school/community relationship encourages the use of the school year round, both for primary education and for community functions.

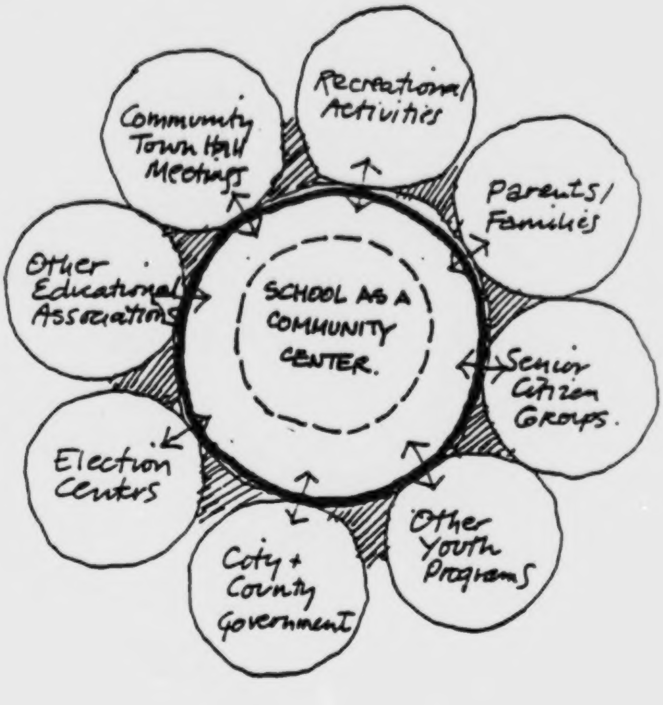
Recreational/ Activities
Community Town Hall Meetings
Parents/ Families
Other Educational Associations
SCHOOL AS A COMMUNITY CENTER.
Senior Citizen Groups.
Election Centers
City + County Government
Other Youth Programs

Figure 5.1. School as a community center / necklace of community activities.

Team Suites / Clusters of Classrooms

A common educational reform trend is the classroom suite, sometimes called the "Self-Contained Classroom Community" or "The Pod School." The philosophy behind this reform idea and design prototype is that teachers and students together constitute a small community. Variations on this theme include cooperative learning, new versions of team teaching, Ted Sizer's notion of teachers as team coaches, and the school as a mirror of the emerging workplace. In one interpretation of this philosophy, the Koln-Holweide model, teachers are divided into small, relatively autonomous teams (6 to 8 teachers), with each team being responsible for one group of students. The teams stay with their students from the fifth grade until the tenth grade.

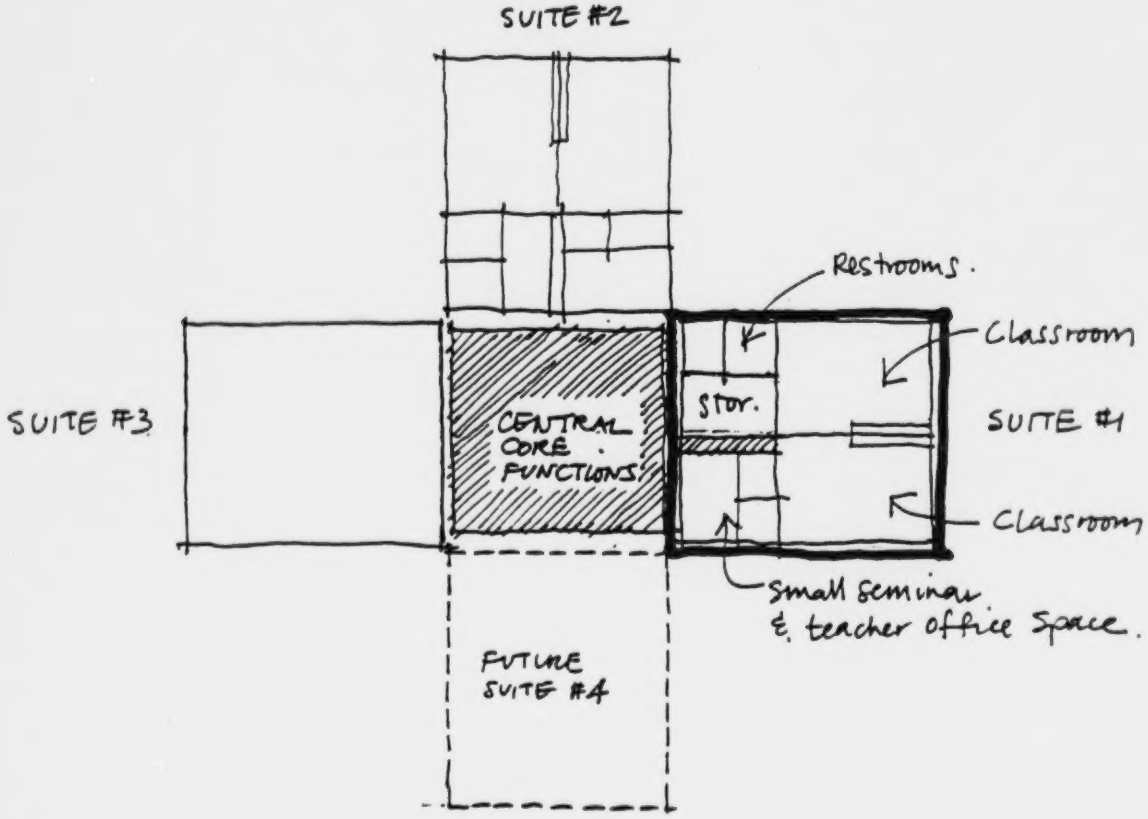
SUITE #2
Restrooms.
Classroom
SUITE #3
CENTRAL CORE FUNCTIONS
Stor.
SUITE #1
Classroom
Small Seminar
& teacher office Space.
FUTURE SUITE #4

Figure 5.2. Team suites / clusters of classrooms.

The architectural response is to create a series of small suites of classrooms and support facilities around the central core functions. Among the support facilities may be lounges, informal learning spaces, a small computer hub, office space for teachers, lockers private bathrooms, display cases and small seminar rooms. Layouts can accommodate different teams and community philosophies: classrooms can vary according to size and openness, the relationship of the teachers' offices to classroom space can vary, etc.

Strickland & Carson Associates' design for School Site Number 1 in the Bronx, reported in New Schools for New York in the Winter 1990 *Teachers College Record*, included suites for an inner-city school each with classrooms, lounge space, office space for teachers, lockers, private bathrooms, window seats, terraces, hallway display cases, and smaller seminar rooms. The philosophy behind the design prototype, and this pattern, is that teachers and students together constitute a small community, or a "family" in a "house."

Supervisable Circulation Paths

Ambiguous circulation patterns impede children's use of schools and create unnecessary chaos and disorganization. The central educational issue with regard to circulation is "substance" time versus "non-substance," "transitional," or "preparatory" time. Studies by Paul Gump in 1975 found that more non-substance time is spent by children in open-plan schools than in closed-plan schools, with much of this being transit time between activities. Various design researchers (e.g., Fred Osmon, Anne Taylor, and our own work) have suggested that circulation patterns surrounding activities may encourage children to look around and see what is available, that fluid traffic patterns provide a means for better communication. Studies conducted in our own labs have found more teacher-teacher communication and a wider variety of interaction among students and between students and learning materials in early childhood education centers when circulation was clear and not disruptive of activities.

Supervisability, however, is a major problem for teachers and administrators in Milwaukee's inner city schools, as it is in most other major city school systems, and must be addressed in some fashion. There is a desire by educators to provide circulation corridors which provide passing opportunities for learning through the use of activity pockets for free-standing display cases, wall-mounted tack-boards, and pockets off the main corridor which contain vision glass into a specialty classroom. Corridors have been traditionally a convenient location for lockers. Architects often recess classroom entrances and stagger corridors to cut down on the excessive corridor lengths. However, in certain settings, the need for supervision and frequent occurrence of vandalism override the desire for circulation which responds solely to educational or functional needs. Children, in these circumstances, can hide in various nooks and crannies located off the corridor out of the sight of teachers or safety supervisors.

When possible, therefore, the circulation path should be cleared of visually obstructing objects to facilitate effective supervision. Clear circulation takes on a different meaning when supervisability is taken into consideration in the planning of a facility.

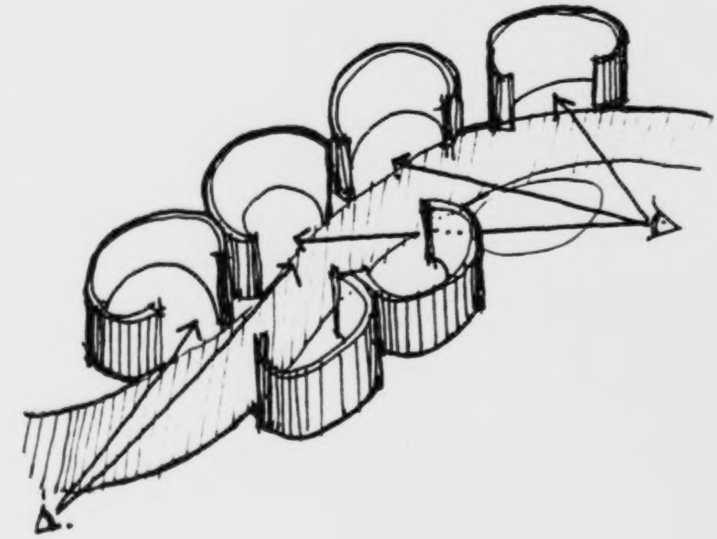

Figure 5.3. Supervisable circulation paths.

Portfolio Process Studio

As schools move beyond traditional assessment strategies and standardized achievement tests, alternative assessment models such as "portfolios" (advocated by such reformers as Grant Wiggins and Holly Houston of the Center on Learning, Assessment, and School Structure, and Ted Sizer of the Coalition for Essential Schools) may become commonplace. Portfolios, it is argued, are means to more authentic testing of process as well as final product of student work, of what a student has actually learned, and a test more aligned with real-world situations.

The design implications for alternative forms of assessment, such as portfolios, has not been sufficiently addressed. The architectural design pattern which arises out of the notion of portfolio is the need to provide appropriate space for working on, storing, and exhibiting student portfolios. This space must accommodate a wide range of activities, including but not limited to A/V studio productions, dance and other similar types of live performances, individual project work space, large open project tables, a gallery to display work, and staging areas.

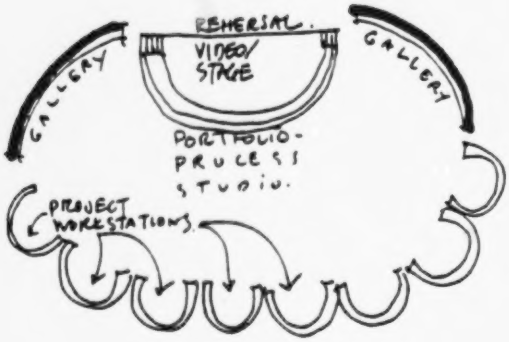
REHEARSAL
VIDEO/STAGE
GALLERY
GALLERY
PORTFOLIO-PROCESS STUDIO
PROJECT WORKSTATIONS

Figure 5.4. Portfolio process studio.

Cluster of Teacher Offices

The need for a new professionalism among teachers has been recognized by educational reformers. The Carnegie Foundation for the Advancement of Teaching (1990) found that the nation's teachers "see themselves less involved in key school decisions [and] find working conditions unsatisfactory." Ernest Boyer, president of the foundation concluded that "improved working conditions are essential if we hope to attract and hold outstanding teachers. They must be regarded as professionals, treated as professionals, and consider themselves to be professionals. Unless we create an environment in the schools...that sustains such an attitude, we cannot expect improvements to occur." If teachers are to be treated as professionals sharing decision making, then quality, private working space (which includes telephones, fax machines, computer terminals, etc.) should be provided.

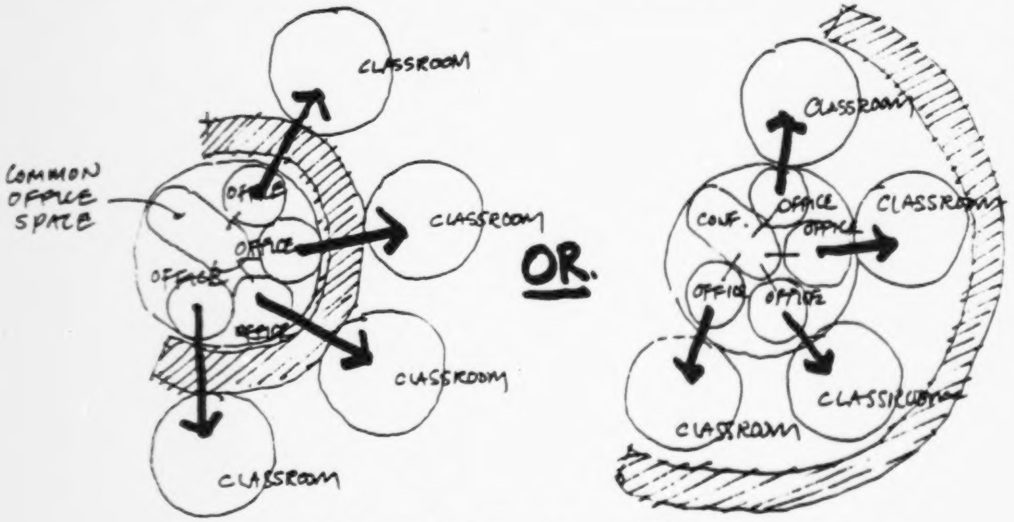
CLASSROOM
COMMON OFFICE SPACE
OFFICE
CLASSROOM
OFFICE
OFFICE
OFFICE
CLASSROOM
CLASSROOM
OR.
CLASSROOM
CONF.
OFFICE
OFFICE
CLASSROOM
OFFICE
OFFICE
CLASSROOM
CLASSROOM

Figure 5.5. Cluster of teacher offices

The Development of Patterns as a Collaborative Process

As will be discussed further in Chapter 8, we believe that the development and use of design patterns be a collaborative dialogue between researchers and practitioners from both the architectural and educational professions. In addition, there is a need for a process view of the implementation of these reform ideas, both educationally and architecturally. For instance, the design patterns presented here represent a fraction of the number of patterns which may have arisen from the work of many architects and educational researchers over a span of 30 years which have not been identified. As educational philosophies continue change into the 21st century, many new patterns will arise which have not been suggested by either empirical, educational or architectural literatures.

The implications of this process view further suggest that new design patterns will emerge from the feedback of students, teachers, and administrators in school facilities as they struggle to implement these and other reform ideas. Including students and teachers in the process of identifying design patterns which work will not only increase their environmental awareness of the possible use and management of classroom space, but may further support the spatial and environmental implications of educational reform ideas at a grassroots level.

The critical importance of the physical environment of the school in supporting educational program reforms should not be ignored. The success of the educational reforms of the 1990s will depend, in part, on the support these reform programs receive from the physical setting in which they are placed.

CHAPTER 6

TWENTY-SEVEN PATTERNS FOR THE DESIGN OF THE NEXT GENERATION OF AMERICAN SCHOOLS[20]

When the first of us (GTM) was commissioned to review the literature and invited to give a keynote talk at the Second National Conference on Architecture and Education, and invited the second of us (JAL) to assist in the process, we were happy to accept the invitation as we thought it would give us an opportunity to review the educational and architectural literatures looking for communalities and divergences. We also thought it would give us the chance to find out (and communicate) the major findings from the educational research literature on the impacts of school design on educational program effectiveness, and then to translate the major findings into a set of design principles or patterns for the new American schoolhouse. This, at least, is what the conference organizers asked the first of us to do in the invitation, and what we all hoped would be possible. Some years ago, Tom David and Ben Wright edited an excellent book on *Learning Environments* (University of Chicago Press, 1974) and more recently, Carol Weinstein wrote a major review paper on "The physical environment of the school" (*Review of Educational Research*, 1979). We were looking forward to finding the sequels to this comprehensive book and critical review, and to then translating the latest results into design principles and patterns for our discussion.

We scoured the educational, environment-behavior, and architectural literatures in search of new *empirical research*--the 1990s sequels.[21] To our surprise and dismay, relatively little empirical research has been reported in the educational literature on the impacts of school design on educational performance since those important works (cf. Chapter 2). Yes, there are many studies on the impacts of classroom size and overall school size on performance, as well as on the architectural definition of activity spaces and aesthetic appeal, which we have discussed above, but no empirical literature on the myriad of other design decisions which a responsible architect has to make in the course of designing, renovating, or expanding a school building.

On the second side of what may be conceptualized as a three-way triangle, numerous school buildings have been published in the *architectural press*, but with infrequent critical commentary. As Jeff pointed out in some of his notes to me, many of the buildings look friendly and non-institutional, massing has been broken down into residential building-scaled forms, with sloped roofs, open and operable windows, and intimate spaces inside, and, in some cases, corridors have become indoor "streets" for incidental socializing and unstructured teaching. But the commentaries in the architectural press, where they exist at all, talk about the uniqueness of the design of these schools, and whether the design (the polychromatic brickwork, intricate stucco details, and cute bell or clock towers, etc.) evoke picturesque or excessively post-modern images, not whether they lead to better teaching/learning environments for the users nor, most fundamentally, whether they have any impact on educational performance.

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[20] An earlier version of this chapter was presented as the major portion of a keynote address by Gary Moore with considerable assistance from Jeff Lackney at the Prairie School National Invitational Conference on Architecture and Education, Prairie School and Wingspread Conference Center, Racine, Wisconsin, May 16, 1992. Our thanks to the Johnson Foundation for supporting the research effort which led to this chapter.

[21] On-line data-base searches were made of all the architectural, educational, and psychological literature between 1980 and 1992 using the Dialog, BRS Information Technologies, and ERIC data-bases.

Most surprising of all are the series of annual "Architectural Portfolios," award-winning and other outstanding school buildings judged by and published in *American School & University*. Page after page of buildings are published, for the most part with descriptive comments only. There are some valuative commentaries like, "The master plan takes advantage of the natural terrain by locating the building complex on the higher areas of the site.... Bold forms, restrained use of materials and color, precision detailing, the play of sun and shadow, wonderful site and siting ... this is architecture as art! There's more to learn here than the three R's" (*American School & University*, November 1989, p. 36). The introduction, presumably the most important insights of the jury, was titled "Presentation Quality is Paramount in Communicating Facilities Design."

The third side of the conceptual triangle is the educational reform literature (e.g., Fiske, 1991; Sizer, 1992). Here the literature is proactive, compelling, based on many years of experience of some of the continent's most innovative and brightest thinkers about education. It is not research. It is not architecture. In many cases, there is no discussion of architecture. And yet, when one reads this literature with an architectural eye, much of it is pregnant with ideas, ways in which the appropriate design of educational facilities can set the stage for more easily, efficiently, and productively achieving the latest educational reform ideas.

Twenty-seven Design Patterns for the New American Schoolhouse

Despite the lack of comprehensiveness, there *is* empirical data on the impact of school design on important performance issues (including the effects of school and classroom size, flexible learning facilities, open space, aesthetic appeal, well-defined activity areas, indoor climatic factors, acoustics, and lighting--much of which is reviewed above in Chapter 2 and need only be reviewed briefly here). There also are some clear *trends* in school design apparent from the architectural literature (the campus-plan concept, the pod school or clusters and suites of classrooms, William Brubaker's "great spaces," and so on). And we have been able to inductively arrive at some working hypotheses about ways in which formal characteristics of design can set the *stage* for educational reform ideas.

Thus we have developed what we think are a set of the most important 27 design patterns for the new American schoolhouse.[22] Each of our ideas, or *patterns,* is a design principle that we believe may be able to help shape the form of the new American schoolhouse. Two of these patterns, developed in response primarily to the empirical EB literature, were presented in Chapter 5; five additional patterns in response primarily to the educational reform movement, were presented in Chapter 6.

A word about what is a *pattern* in architecture (cf. Alexander, Ishikawa, & Silverstein, 1977). *A pattern* is the core of a design solution to an issue or problem that occurs over and over again in the built environment, in this case, in educational facilities. Our attempt has been to state patterns in a way that they can be used over and over again, without ever doing it the same way twice. Important parts of the pattern are the *diagram* and the *title,* both of which, if they are good, express the core of the idea visually and verbally. The redundancy between visual and verbal message is intentional. Some people are more visual and will understand and remember the visual image (the hashed circulation arrow meandering between activity areas and children) while others will understand the idea better and remember the verbal title ("supervisable circulation paths"). Because the pattern is the essential idea, but can be used over and over again in many different ways; there is a one-to-many relationship between the pattern (diagram and title) and any particular building examples. The pattern is the idea--the abstraction; the examples are different ways in which one might actually do it--the concrete particular.

The patterns are organized into four clusters:

- Planning Principles
- Building Organizing Principles
- The Character of Individual Spaces
- Critical Technical Details

This list is by no means exhaustive. We hope that your critical reading of them will help us to refine the list, combining or deleting redundant patterns and developing needed new ones. At the present time, the set of 27 patterns includes the following:

- Planning Principles
    1. And the Winning School is . . . Smaller
    2. School as a Community Center / Necklace of Community Activities
    3. Safe Location
    4. Contextual Compatibility

---

[22] Some of these design notions, like Great Spaces, have been directly influenced by Bill Brubaker's "These 21 Trends Will Shape the Future of School Design"; others have been influenced by Susan Stuebing's Learning Environments Research and Sara Crumpacker's phenomenological work on "The Experience of School as Place," all of whom we thank.

- Building Organizing Principles
  - 5 Campus-Plan Concept / Schools within Schools
  - 6 Compact Building Form
  - 7 Building Core / Community Forum
  - 8 Team Suites / Clusters of Classrooms
  - 9 Great Spaces
  - 10 Modified Open Space
  - 11 Supervisable Circulation Paths
  - 12 Flexible/Adaptable Learning Facility
  - 13 Home as a Template for School
  - 14 Design Diversity

- The Character of Individual Spaces
  - 15 Small Classrooms
  - 16 Variety of Learning Spaces
  - 17 Well-Defined Activity Pockets
  - 18 Table Groups
  - 19 Nested Classroom Groupings
  - 20 Portfolio Process Studio
  - 21 Administration in the Mainstream
  - 22 Cluster of Teacher Offices
  - 23 Indoor-Outdoor Transition Spaces
  - 24 User-Friendly / Child-Centered Aesthetics and Scale

- Critical Technical Details
  - 25 Controlled Indoor Climate
  - 26 Appropriate Acoustics
  - 27 Natural/Full-Spectrum Lighting

Planning Issues

1. And the Winning School is ... Smaller

The first issue to be addressed in educational facility planning is the optimal overall size of school buildings. The Public Education Association has argued for downsizing schools to 500 to 600 pupils per school. The argument goes that smaller is better, that smaller schools will lead to a more humane educational system. But what is the evidence?

Over 300 studies were conducted on size between 1965 and 1980 (Garbarino, 1980). The findings are quite consistent. In comparison to large schools (over 1000 students), small (400-500 students) and medium-sized schools (900-1000 students) have better educational records. More student are involved in governing decisions. All other things held equal, there is less crime. There is more sense of responsibility. Discipline is higher; for example, less misconduct was found after one school subdivided its 3,000 students into a number of smaller schools. Large schools have been found to undermine character development and socialization to adulthood (Garbarino, 1980) by not providing a full range of participatory activities. Conversely, students in smaller and medium-sized schools take more part in extra-curricular activities, there is more overlapping of roles, they are more satisfied with the participation, and overall they have more positive self images (King & Marans, 1979).

So what is the optimal overall size of school buildings? The Public Education Association recommends downsizing schools to 500 to 600 pupils per school, arguing that smaller schools will lead to a more humane educational system [our diagrams show two schools for ca. 720 students]. Small and medium schools have better educational records, more students are involved in governing decisions, there is less crime, there is more sense of responsibility, and discipline is higher (Garbarino, 1980).[23] As Paul Goldberger's review of the design competition for "New Schools for New York" concluded, "Educators have begun to suggest that the real sin in contemporary school design is size ... and the winning school is ... smaller" (Goldberger, *New York Times*, May 27, 1990).

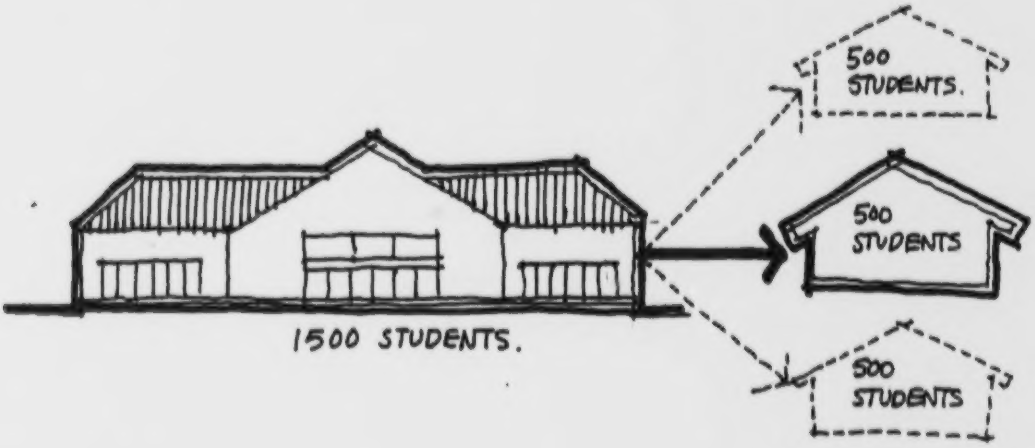

Figure 6.1. And the winning school is ... smaller.

2. School as a Community Center / Necklace of Community Activities

Though we have found no environment-behavior research on the topic, a wide number of commentators (e.g., Janet Felsten of the Baltimore Foundation for Architecture) have suggested that one of the important new educational directions for the 21st century schoolhouse is integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and making the school a community hub. Several new schools and ones on the drawing boards for New York City have taken this position. The *American School Board Journal* of May 1990 reported that the construction of community recreation centers as part of schools has been found to be a solution for building community support for public education among a growing number of community residents who do not have children of their own in school. Centers are schedule so everyone in the community can use them. In some cases, an adult education program is set up as well as a "Top 55 Club" for senior citizens. Schools are becoming expected to house child care centers. Other examples of including continuing and job-training educational programs, youth programs, programs for parents and families, administration offices, social services, and facilities for community and town hall meetings abound. As done in the Desert View Elementary School (*Architecture,* 1989, *78*(5), 139), a multipurpose pavilion and cafeteria which is shared by the community is oriented towards a public entry plaza. In the Lago Lindo School in Edmonton (*Canadian Architect,* 1991, 369, 17-25), a simple urban piazza connects the school to a future community building, effectively ordering both the building and its site. The piazza, a major gathering spot for the school, has also become a focal point for the community. It is only a short step from the school as a community hub to using the school year round, both for primary education and for community functions.

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[23] From over 300 studies conducted on size between 1965 and 1980 (Garbarino, 1980).

Architecturally, in many cases, the building wraps around the community functions, as around a "town square." In others, the community functions are a necklace around the school. In either case, parking obviously needs to be located near the public use facilities (gym, library, performing arts facility, etc.).

Schools of the future will be highly integrated with other community functions. One of the important new educational directions for the 21st century schoolhouse is integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and making the school a community hub. Ted Fiske, in *Smart Schools, Smart Kids* points out a number of innovative "learning communities," turning schools into centers for child advocacy, including some 70 community organizations dealing with health, social services, recreation, and housing. In some cases, an adult education program is set up as well as a "Top 55 Club" for senior citizens. Schools are becoming expected to house child care centers, continuing and job-training educational programs, youth programs, programs for parents and families, administration offices, social services, and facilities for community and town hall meetings. Architecturally, the school may wrap around the community functions, as around a "town square." Or the community functions can be a necklace around the school. The school as a life-long learning community.

This pattern is in response to a wish for a broadening and deepening sense of community, to the school as a life-long learning community.

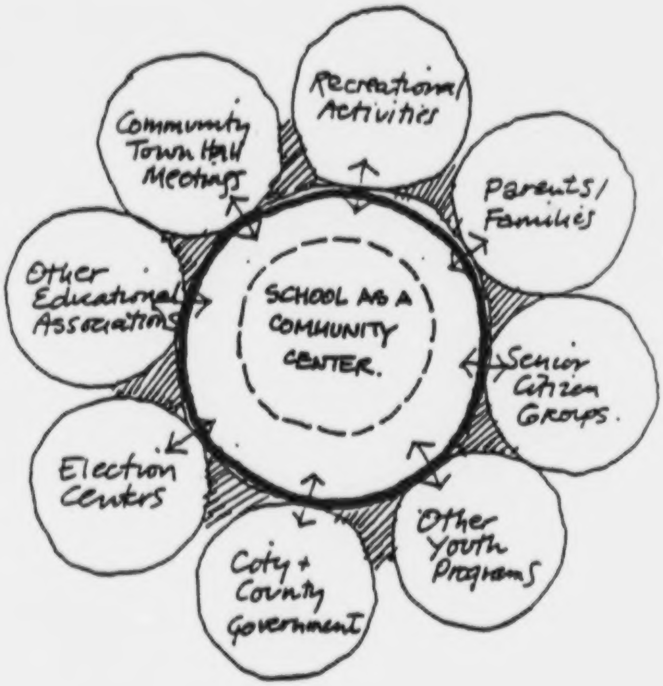
Community Town Hall Meetings
Recreational/ Activities
Parents/ Families
Other Educational Associations
SCHOOL AS A COMMUNITY CENTER.
Senior Citizen Groups.
Election Centers
City + County Government
Other Youth Programs

Figure 6.2. School as a community center / necklace of community activities.

3. Safe Location

Other physical planning and design variables are important for student performance. For instance, the location of new schools is now known to be critical. A series of studies in this country between 1980 and 1986 reviewed by our colleague Gary Evans in *New Directions in Health Psychology Assessment* concluded there are significant increases in blood pressure associated with schools being near noisy urban streets. Other findings related to location include German and Russian studies indicating increased systolic and diastolic blood pressure in middle-school children in schools close to noisy urban streets and abnormally high blood pressure in children residing around nine different Soviet airports. Exposure to traffic noise at school also has been associated with deficits in mental concentration, making more errors on difficult tasks, and greater likelihood of giving up on tasks before the time allocated has expired among elementary school children. Furthermore, as found by Sheldon Cohen and his colleagues in Los Angeles, elevated blood pressure does not habituate or decline with continued noise exposure over time--children don't get used to it. The correct location of new schools, and their proper architectural design can alleviate noise and other problems.

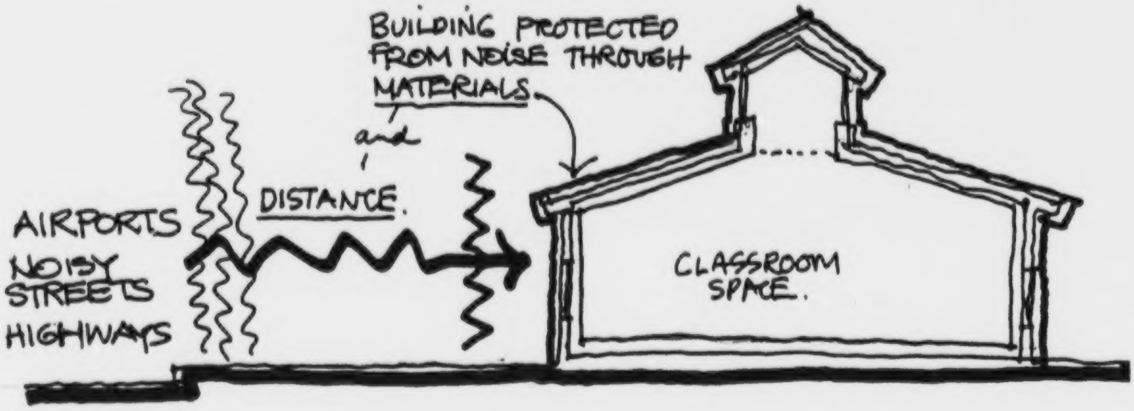
BUILDING PROTECTED FROM NOISE THROUGH MATERIALS.
and
DISTANCE.
AIRPORTS
NOISY STREETS
HIGHWAYS
CLASSROOM SPACE.

Figure 6.3. Safe location.

4. Contextual Compatibility

Contextual Compatibility is the notion of trying to fit the school into the character of the local community. For example, California and the west have a particular style of design; what is appropriate there in terms of contextual comparability, e.g., a campus centered around a plaza, may not be relevant for the rest of the country. Pitched and visible roofs may be very appropriate in suburban areas of the country, but the more general pattern is emerging is the general notion of contextual comparability. While a valid concept architecturally, we know of no evidence linking this notion to school performance.

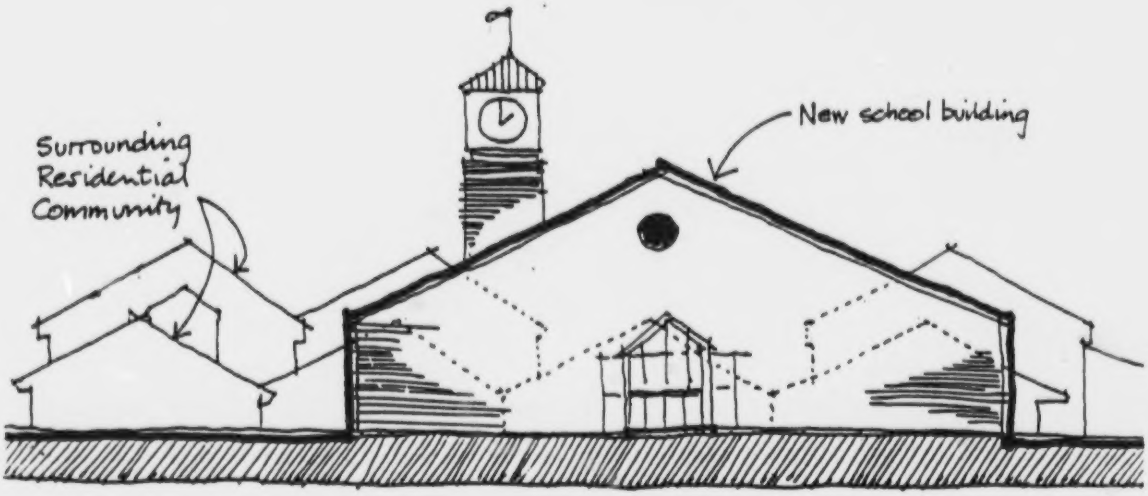
New school building
Surrounding Residential Community

Figure 6.4. Contextual compatibility.

Building Organizing Principles

5. Campus-Plan Concept

As reviewed above, there is considerable empirical evidence and public support for the notion of smaller school sizes, around 500 to 600 students for elementary and middle schools and 1,000 for high schools. Research has mounted that quality education is highly dependent on small-group sizes (Ruopp, 0000). The two critical sizes are the number of children in a primary group (which influences class size) and the total number of children in a school. On the other side of the issue is cost containment, that larger programs are less expensive resulting from an economy of scale. One way of handling the dilemma of cost to quality is what we previously have called the village or Campus-Plan Concept,[24] i.e., decentralized the building plan into an interrelated set of pods, modules, or houses.

The basic pattern is that whenever and wherever a school is to house more than 600 elementary or middle school students or more than 1,000 high school students, plan the center (both in terms of program philosophy, administration, and facilities) as a village, campus, or articulated multi-faceted building comprises of a series of interconnected schools-within-a-school for 500-600 elementary or middle school students and not more than 1,000 high school students. The essence is the idea of separated yet related schools-within-a-school, separated yet related administratively and architecturally.

In some cases, the architectural form is a series of academic wings or specialized program functions around a media or resource center or a large multipurpose, community facility. In one example, the building is divided into two main clusters (K-2 and 3-5), each cluster having its own commons and entrance. A main core space is placed between the clusters, the resulting design successfully breaking down the scale of the building. In a case published in the *Architects' Journal* (1990, *192*(6), 13), a series of low buildings are grouped around a field in the tradition of the British comprehensive school. A building reviewed by Brian Allsopp in Edmonton (*Canadian Architect,* 1991, *36*(9), 17-25), the massing of the building has been broken down into appropriated scaled residential building forms, with sloped roofs, open windows, and intimate spaces inside. In another example, the Calling Lake Elementary and Junior High School, an arcade was added to the original building and the exteriors of each new classroom were articulated as a row of small unties each with its won front door. The result reminds us of a group of small traditional single room schoolhouses, breaking down the scale of the school into a village or campus plan.

Research has mounted that quality education is highly dependent on small-group sizes. Small schools work better. The two critical sizes are the number of children in a primary group (which influences class size) and the total number of children in a school. On the other side of the issue is cost containment, that larger programs are less expensive resulting from an economy of scale. One way of handling the dilemma is what we previously have called the village or campus-plan concept--a decentralized building plan. The idea is separated yet related schools-within-a-school, separated yet related administratively and architecturally, a series of academic wings or even separate "houses" (K-2, 3-5) for approximately 210 to 360 students (Sizer, 1992), each with its own commons and entrance, the resulting design successfully breaking down the scale of the building.

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[24] Moore, Lane, Hill, Cohen, & McGinty (1979, 3rd rev. ed. 1994), *Recommendations for Child Care Centers* and Moore, Piwoni, & Kennedy (1990), "Designing Child Care Environments using the Children's Environments Pattern Language," in the *Children's Environment Quarterly.*

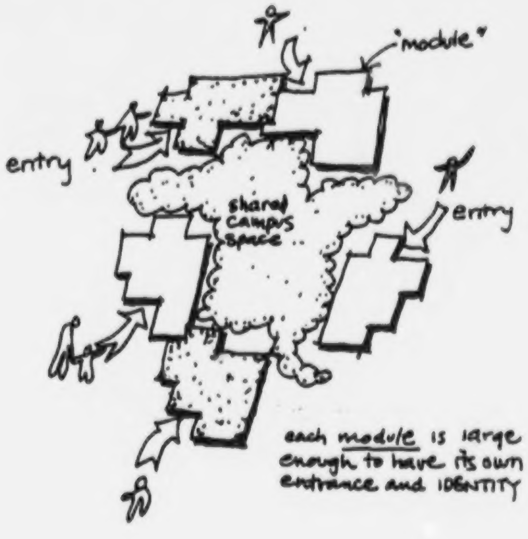
"module"
entry
shared campus space
entry
each module is large enough to have its own entrance and IDENTITY

Figure 6.5. Campus-plan concept.

6. Compact Building Form

In his excellent and influential article on trends in school design (*American School Board Journal*, April 1988, *175*(4), 31-33, 66), Bill Brubaker suggests that the campus plan in which a school consists of a number of separate but related buildings, makes good sense in places where the weather is warm year-round. In contract, he argues, a single, compact, multi-floor building might be more appropriate where the winters are cold. The most compact plan imaginable would be a sphere, but for its difficulty in laying out spaces on earth (as opposed to lunar or Martian design situations), a cube is the earthly equivalent. He mentions a high school in Chicago which is a cube-shaped high-rise--140 feet (42.68 m) wide, long, and high.

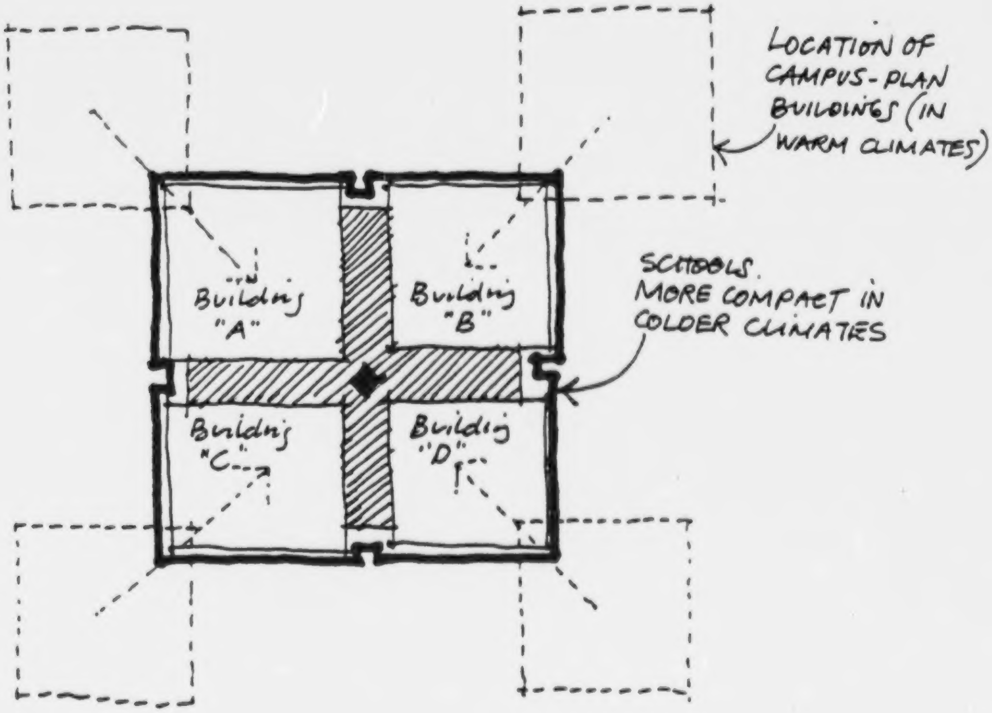
LOCATION OF CAMPUS-PLAN BUILDINGS (IN WARM CLIMATES)
SCHOOLS. MORE COMPACT IN COLDER CLIMATES
Building "A"
Building "B"
Building "C"
Building "D"

Figure 6.6. Compact building form.

7. Building Core / Community Forum

A design pattern relating driven by the economic use of limited resources with implications for facility design is the Building Core concept. Berg and Apostle (1991) report on how a bond issue campaign helped build new schools, and the use of prototype designs to capitalize on economies of scale. As with other buildings, the resulting design consisted of a Building Core comprised of common-use spaces such as the library, multi-purpose rooms, special education classrooms, administrative complex, and mechanical and electrical spaces. In many cases, traditional classroom wings branch off from the core as required by the program (see the following pattern, Clusters/Suites of Classrooms).

The aesthetic aspects of several of these schools built around a core are worth mention--the differences in ceiling heights, use of color, exciting shapes and forms, and, in one case, an amazing centralized 2-1/2 story library space (where does the money come from?)!

The notion of a building core or community forum is a shared community space as the center or core to the school building. Common-use spaces such as the library, multipurpose rooms, special education classrooms, administrative complex, and mechanical and electrical spaces can be in this core. More fundamentally, the core is a community forum for school-based management, for shared decision making, and as a community forum for other community functions (town hall meetings, etc.)--the core of the school becoming the core of the community.

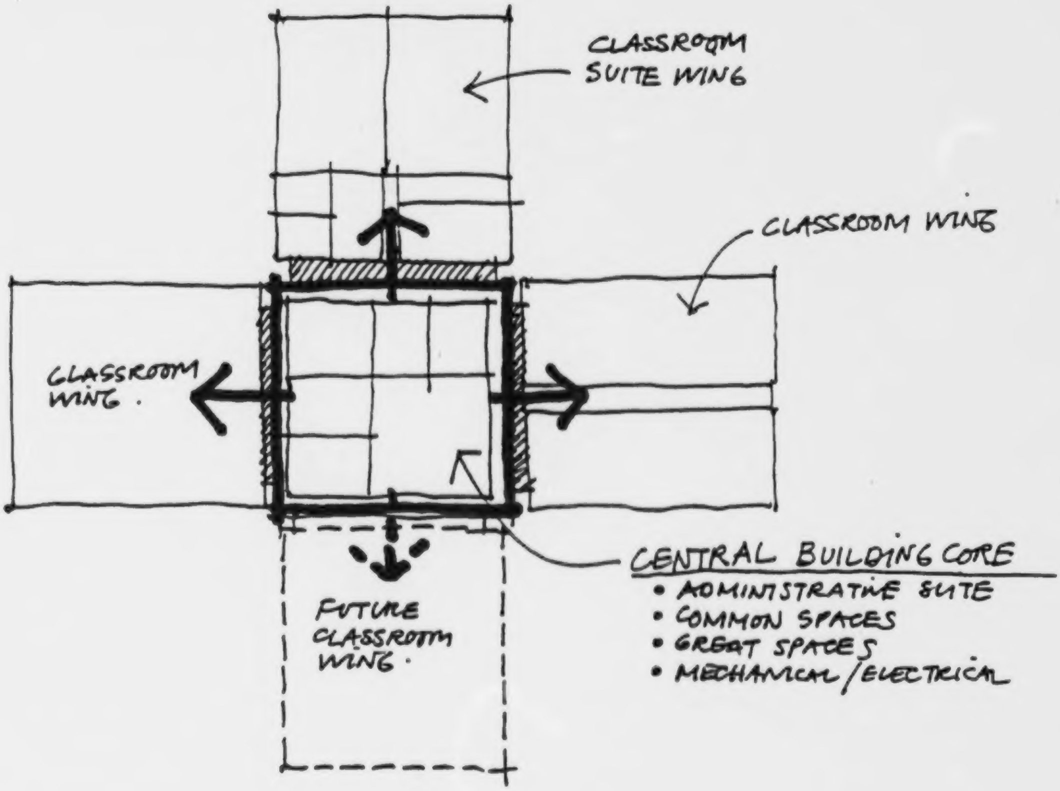
CLASSROOM SUITE WING
CLASSROOM WING
CLASSROOM WING .
FUTURE CLASSROOM WING .
CENTRAL BUILDING CORE
• ADMINISTRATIVE SUITE
• COMMON SPACES
• GREAT SPACES
• MECHANICAL / ELECTRICAL

Figure 6.7. Building core / community forum.

8. Team Suites / Clusters of Classrooms

A common trend, analogous to and driven by the same reasoning but not the same as the Campus-Plan Concept, is the Classroom Suite, sometimes called the "Self-Contained Classroom Community" or "The Pod School." The basic notion here is to create a series of small suites of classrooms and support facilities around the central core functions. Variations on this theme include cooperative learning, new versions of team teaching, teachers as team coaches, and the school as a mirror of the emerging workplace (another variation on the school-within-a-school notion). One interpretation is the Koln-Holweide model as summarized by Ted Fiske: "Teachers divided into small, relatively autonomous teams, with each team responsible for one group of students; the teams, usually six to eight teachers [we show 4-5], stay with their students from the fifth grade until ... the tenth grade" (Fiske, 1991, p. 103). In this layout, the school can accommodate different team/community philosophies. Among the support facilities may be lounges, informal learning spaces, a small computer hub, office space for teachers, etc.

Strickland & Carson Associates' design for School Site Number 1 in the Bronx (reported in the New Schools for New York article in *Teachers College Record*, Winter 1990, 92(2), 248-285) designed suites for an inner-city school including classrooms, lounge space, office space for teachers, lockers, private bathrooms, window seats, terraces, hallway display cases, and smaller seminar rooms.

The philosophy behind the design prototype, and this pattern, is that teachers and students together constitute a small community (another variation on the school-within-a-school notion) and that this can be articulated architecturally.

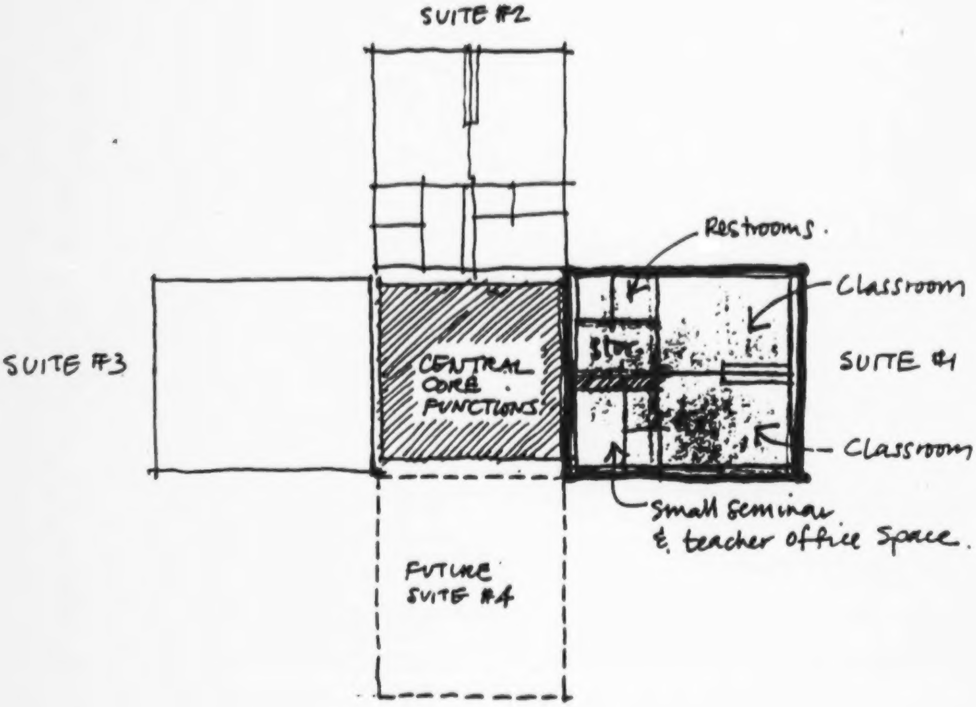

Figure 6.8. Team suites / clusters of classrooms.

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9. Great Spaces

With our next pattern, we again could find no empirical support that the following idea contributes to or detracts from educational performance, but as pointed out by Bill Brubaker, it is definitely an architectural trend in late 1980s and early 1990s school buildings. Large spaces recognize the need for community identity within a school. They also afford connections to the community at large and may act as a symbolic connection of school to community. Large spaces, or as Brubaker calls them, Great Spaces, offer opportunities for lager groups within the school to gather (the see-and-be-seen phenomena so important among middle school and especially high school students). Lobbies and corridors which are wide enough to accommodate and encourage a variety of student social interactions, internal "streets," malls, commons, and atria, each perhaps with higher ceilings, interesting views, and spaces for informal social gatherings come under this design principle.

In several schools reviewed by Brian Allsopp in northern Alberta (*Canadian Architect*, 1991, *36*(9), 17-25), corridors became indoor streets for incidental socializing and unstructured teaching. In a Royal Institute of British Architects Gold Medal Exhibition (*Architects' Journal*, 1989, *190*(5), 69-70), the Birr Community School is seen as being analogous to a town; instead of corridors, there are "streets' linking sequences of houses or Suites of Classrooms at the perimeter.

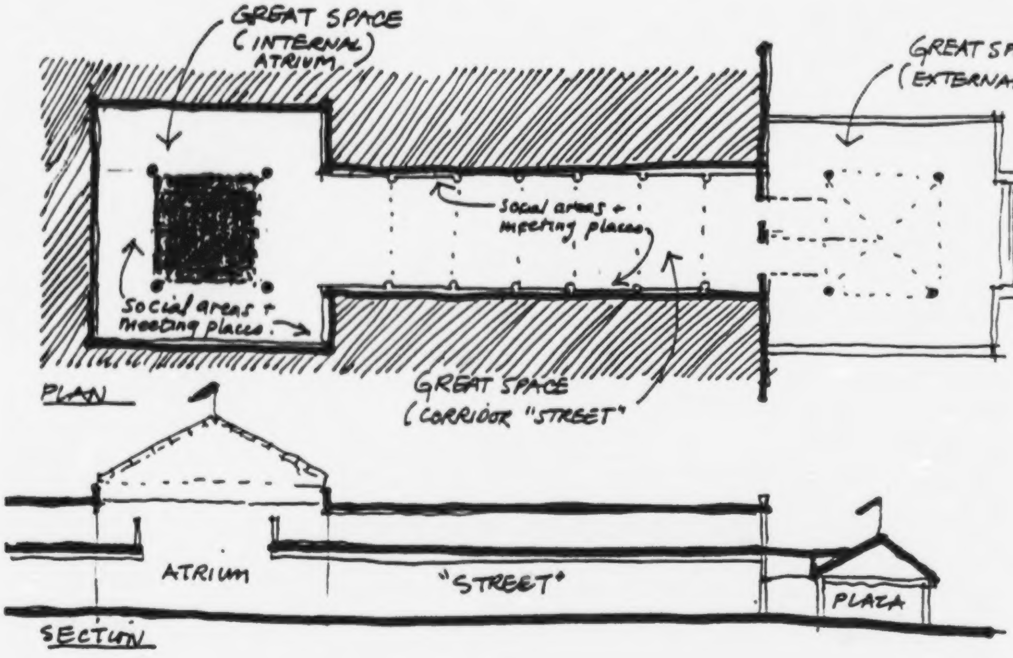
GREAT SPACE
(INTERNAL ATRIUM)
GREAT SPACE
(EXTERNAL PLAZA)
Social areas + meeting places
Social areas + meeting places
PLAN
GREAT SPACE
(CORRIDOR "STREET"
ATRIUM
"STREET"
PLAZA
SECTION

Figure 6.9. Great spaces.

A Great Space may be a courtyard, either enclosed, or it does not have to be enclosed to still serve as a major social space and focal point. The John Paul II Collegiate (high school) in Edmonton uses an outdoor courtyard from the 1950s that was not being used; during renovation it was roofed in with a skylight and made into a student commons area. In the Fox Chapel Area High School, a two-story student commons was created in the renovation by filling in another existing courtyard. A cafeteria was provided which was modelled after a fast-food restaurant, with booths for eating, rather than long impersonal, dining-hall tables. In another example, the renovation of a turn-of-the-century urban high school, the school's library atrium was created by enclosing a little-used outdoor service courtyard (latter two reported in *American School Board Journal*, February and November 1990, 38-40 and 38-39 respectively).

10. Modified Open Space

The building issue, by far, that has been the most controversial and has received the most attention and debate in the educational research literature, in school magazines, and in the architectural press is open space.

Starting with the first open plan schools in the 1950s, the construction of open plan schools passed its peak between 1967-70. But by 1970, over half of all schools built were constructed with open patterns (George, 1975). Critical reviews of the enormous amount of research, and rhetoric, have been written by Carol Weinstein (1979), Gary Evans and Barbara Lovell (1979), and Gump (1987). The contrast, of course, is open plan schools versus conventional, self-contained classrooms--the open school versus the egg-crate school.

The overwhelming evidence in the empirical research literature is that while there is considerable disagreement among building users and administrators, open plan schools have been found to positively impact teacher attitudes and behavior and student attitudes and behavior (Weinstein, 1979), the results vis a vis achievement and overall educational performance are equivocal (George, 1975; Weinstein, 1979; et al.). The two best studies have shown, contradictorily, that conventional classrooms outperform open classrooms on achievement tests (Beck, 1979), and that there are no consistent findings on achievement (Traub et al., 1976). Many open plan schools achieve the objective of exposing children to a wider variety of learning opportunities, but visual and auditory distraction are common complaints in these settings. The volume of open, undifferentiated spaces and the openness of classroom perimeters have been found to be positively correlated with visual distraction (Ahrentzen & Evans, 1984; Moore, 1987). While children are more focused in open plan settings when they are involved in activities, there is more off-task time in such settings in comparison with conventional classroom settings. A type of space division that resolves the dilemma and allows the best of both extremes while minimizing the problems is what we have previously called Modified Open Space (Moore, 1987)--a mixture of several open areas with smaller, enclosed spaces (Weinstein, 1979; Evans & Lovell, 1979; Gump, 1987; D, 1982,

p. 275; George, 1975; Beck, 1979; Traub et al., 1976; Ahrentzen & Evans, 1984; Moore, 1987; cf. Evans, Kliewer & Martin, 1991).

However, having said that about overall educational achievement, the evidence is however clear that certain aspects of open plan schools outperform conventional classrooms, while certain aspects of schools organized in terms of conventional classrooms outperform open schools. Many open plan schools appear to achieve the objective of exposing children to a wider variety of learning opportunities, but visual and auditory distraction are common complaints in these settings. The volume of open, undifferentiated spaces and the openness of classroom perimeters have been found to be positively correlated with visual distraction (Ahrentzen & Evans, 1984; Moore, 1987). While children are more focused in open plan settings when they are involved in activities, there is more off-task time in such settings in comparison with conventional classroom settings.

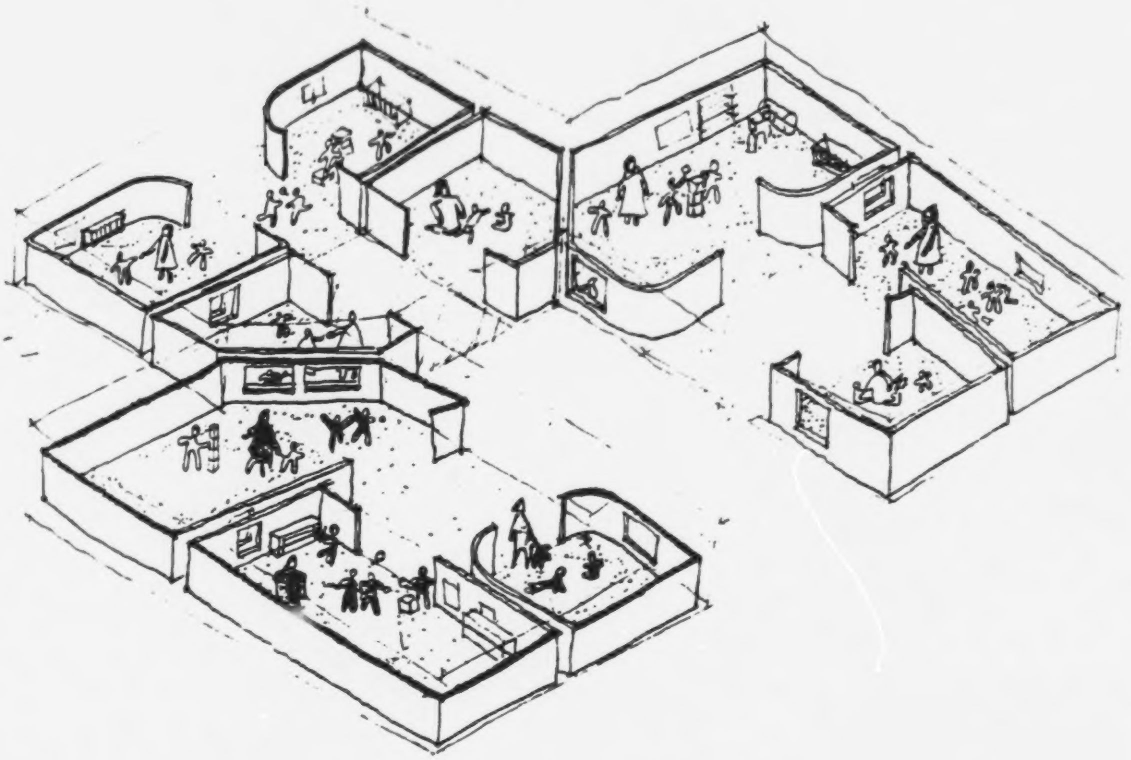

Figure 6.10. Modified open space.

A type of space division that may resolve the above empirical dilemma and allow the best of both extreme alternatives while minimizing the problems is what we have previously called Modified Open Space (see previous page; Moore et al., 1979). It consists of a mixture of several open areas with smaller, enclosed spaces. The open spaces can be subdividable for smaller-group use; the smaller areas can be opened up to each other to provide a large-group area. Indeed, evaluations that we and other researchers have conducted of open plan classrooms modified to become Modified Open Space with separated yet connected activity areas have found improved utilization of space, more involvement and engagement in educational activities and less passive behaviors, fewer classroom interruptions and nonsubstantive questions, and more child-initiated behaviors and exploration (Evans, Kliewer & Martin, 1991; Moore, 1987).

11. Supervisable Circulation Paths

A pattern arising out of the practical experience of educators is that of the "Supervisable Circulation Paths."

Almost a corollary to Modified Open Space is the notion of clear yet Supervisable Circulation Paths. Ambiguous circulation patterns impede children's use of schools and create unnecessary chaos and disorganization. The central issue with regard to circulation patterns is "substance" time versus "non-substance," "transitional," or "preparatory" time. Studies by Gump (1975) have found that more so-called non-substance time is spent by children in open-plan schools than in closed-plan schools, with much of this being transit time between activities. Various design researchers (e.g., Osmon, 1971; Taylor & Vlastos, 1975; our own work, Moore et al., 1979/1989) have suggested that circulation patterns surrounding activities may encourage children to look around and see what is available, that fluid traffic patterns provide a means for better communication. Studies conducted at UW-Milwaukee have found more teacher-teacher communication and a wider variety of interaction among students and between students and learning materials in early childhood education centers when circulation was clear and not disruptive of activities.

There are two aspects of Clear Circulation. One is overall building circulation between and among classrooms. The other is individual classroom circulation, well-defined spaces, clear circulation which overlooks and connects activity areas, and implied boundaries with material changes. Circulation can also be used a social breakout space, providing spaces for students to socialize outside of class.

On the other side of the issue, however, supervisability is a major problem for teachers and administrators in Milwaukee's inner city schools, as it is in most other major city school systems, and must be addressed in some fashion--in a larger context, there is certainly not enough focus in literature on the problems faced by urban school settings.

There is a desire by educators to provide circulation corridors which provide passing opportunities for learning through the use of activity pockets for free-standing display cases, wall-mounted tack-boards, and pockets off the main corridor which contain vision glass into a specialty classroom. Corridors have been traditionally a convenient location for lockers. Architects often recess classroom entrances and stagger corridors to cut down on the excessive corridor lengths. However, in certain settings, the need for supervision and frequent occurrence of vandalism override the desire for circulation which responds solely to educational or functional needs. Children, in these circumstances, can hide in various nooks and crannies located off the corridor out of the sight of teachers or safety supervisors.

When possible, therefore, the circulation path should be cleared of visually obstructing objects to facilitate effective supervision. The need for clear circulation paths takes on a different meaning when supervisability is taken into consideration in the planning of a school facility.

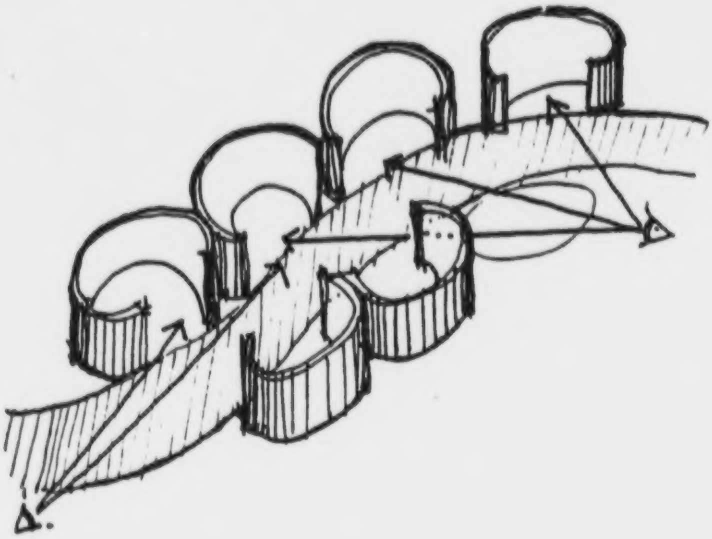

Figure 6.11. Supervisable circulation paths.

12. Flexible / Adaptable Learning Facility

There is some, though limited, evidence that flexible learning facilities lead to higher attendance and more participation in schools. In reviewing the results of the New Schools for New York project, Rosalie Genevro (1990) suggested the value of schools having rooms in a variety of sizes to accommodate classes and smaller discussion groups as well as large assemblies and community events. This is flexibility. Schools need also to be adaptable to be able to adjust to changing enrollment patterns, educational philosophies, and community needs over time. This is adaptability.

Bill Brubaker has suggested that built-in flexibility can be achieved if newer buildings would minimize interior load-bearing walls, use long-span structural systems, and incorporate a range of room sizes to allow for adaptability and flexibility.

Flexible learning facilities may lead to higher attendance and more participation in schools (find source?). Rosalie Genevro, in reviewing the results of the New Schools for New York project, suggested the value of schools having rooms in a variety of sizes to accommodate classes as well as smaller discussion groups as well as large assemblies and community events (Genevro, 1990). In the prototypical designs we will show in Chapter 7, we have recommended and designed project rooms, and the "portfolio process studio." This is architectural flexibility, for flexibility of education. Schools need also to be adaptable to be able to adjust to changing enrollment patterns, educational philosophies, and community needs over time. This is adaptability.

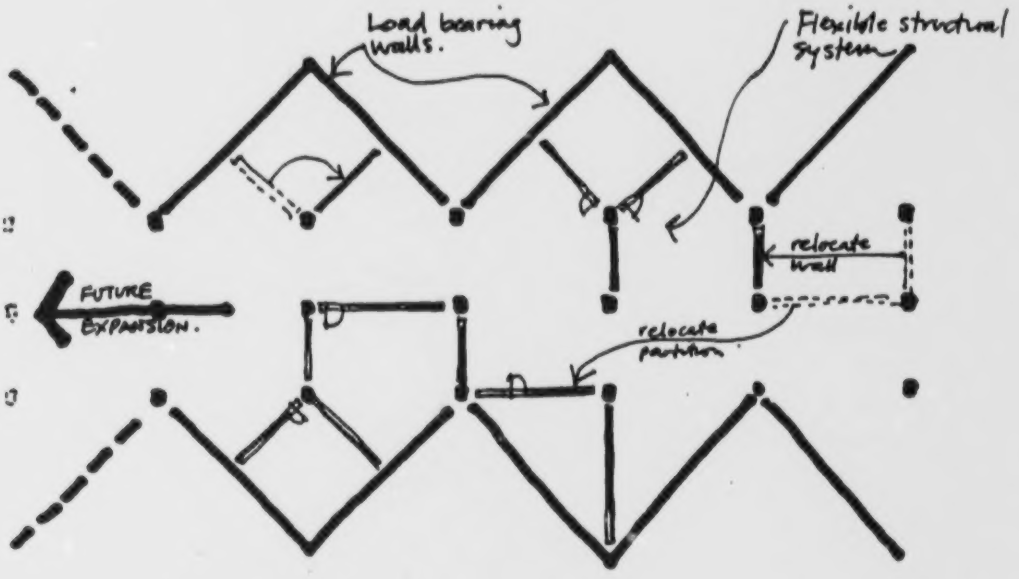

Figure 6.12. Flexible/adaptable learning facility.

13. Home as a Template for School

A new educational direction that is emerging on the American scene is making schools look more like and feel more like homes. Is there any hard evidence that this matters, or leads to measurable educational gains? We haven't been able to find any. But the phenomenological work of Sara Crumpacker combined with the environmental psychological work on transitions by Seymour Wapner at Clark University suggests the possible importance of minimizing the abrupt transitions between home and institutionalized educational facilities, especially for very young children. Our own previous work advocated the creation of home-like front yards and front porches, and a friendly entry sequence, for child care centers and other early childhood education facilities as a possible way of reducing anxiety about school and reassuring both child and parent that the facility will be home-like in overall functioning (Moore et al, 1979). The use of pitched and visible roofs is another design response to this general pattern of the Home as a Template for School.

There are many examples appearing in the architectural literature--in the US, Canada, and overseas--of schools that are using home-like elements in their design. Pitched and visible roofs, residential scaled and colorful and aesthetically pleasing entrances, shutters on windows reflecting neighborhood homes, and many good examples of residential looking design, even to the extreme of a 1991 school which literally resembles a residential neighborhood with one-story sloped roofs, classrooms engaging the surrounding landscape, and enclosed "backyard" space for outdoor learning activities.

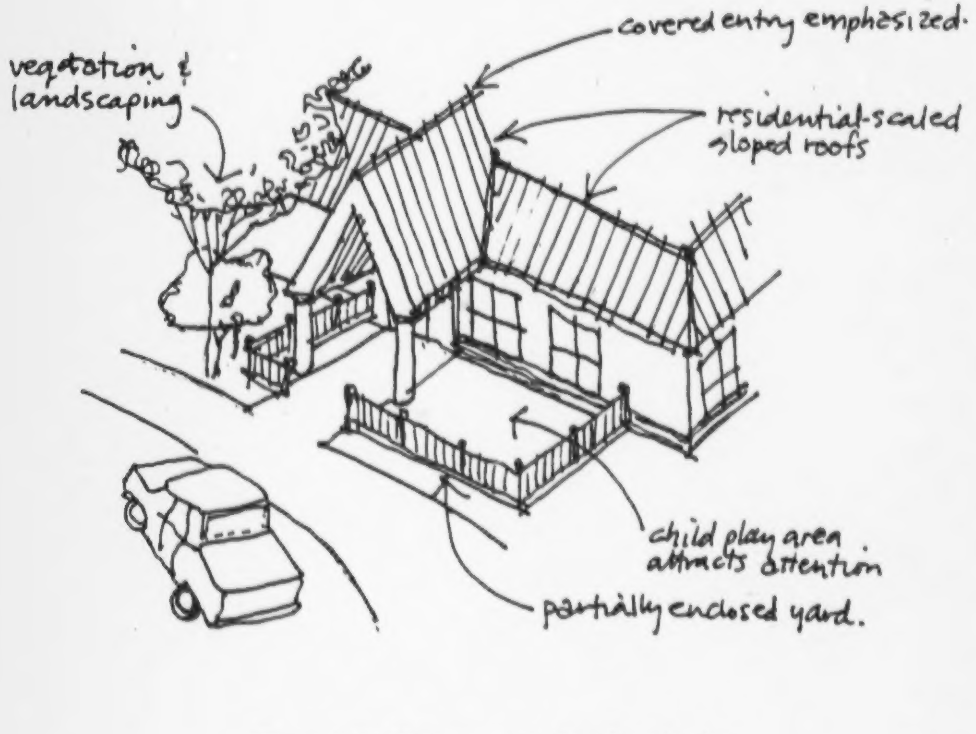
covered entry emphasized.
vegetation & landscaping
residential-scaled sloped roofs
child play area attracts attention
partially enclosed yard.

Figure 6.13. Home as a template for school.

14. Design Diversity

Highly related to the Home as a Template for School is Design Diversity. Schools of the 1950s and 1960s were very institutionalized in character, some even being industrialized construction "boxes" with no exterior windows looking for all the world more like warehouses than interactive learning environments for our next generation. Such buildings won't disappear from the school scene, but we can welcome the design diversity that has emerged with the new interpretation of high-tech design elements and post-modernism and the use of traditional design details and materials. The use of vaulted ceilings in kindergarten and special education settings within comprehensive schools adds to the variety and interest of the spaces (and maybe contributes to effective acoustics as well) of classroom settings.

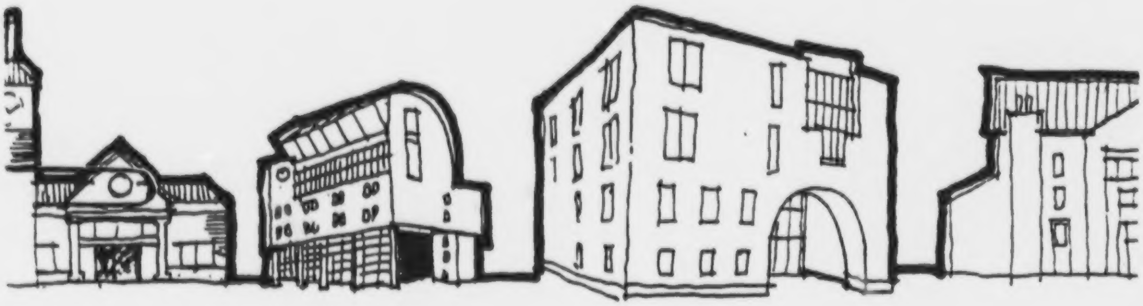

Figure 6.14. Design diversity.

The Character of Individual Spaces

15. Small Classrooms

Considerable research on density and crowding in classrooms leads to an unmistakable conclusion--that smaller is better. Higher absolute density and greater perceived crowding have been found to be associated with decreased attention, lower task performance, some behavioral problems like increased aggressive behavior, and social withdrawal. As Carol Weinstein noted, "Nowhere else are large groups of individuals packed so closely together for so many yours, yet expected to perform at peak efficiency on different learning tasks and to interact harmoniously" (1979, p. 585).

Other research on classroom size has found a number of very stable, corroborating findings. Classes under or equal to 20 children, in comparison to ones over 25, have been found to lead to better learning attitudes, different and varied instructional practices, higher teacher satisfaction and morale, and, most importantly, higher achievement scores (Bourke, 1986). As was said some years ago in the National Day Care Study, the size of group in which the child spends the most time makes an incredible difference in the quality of education and development.

Research on density and crowding in classrooms leads to an unmistakable conclusion--that smaller is better here too. Higher absolute density and greater perceived crowding are associated with decreased attention, lower task performance, some behavioral problems like increased aggressive behavior, and social withdrawal. As Carol Weinstein noted, "Nowhere else are large groups of individuals packed so closely together for so many years, yet expected to perform at peak efficiency on different learning tasks and to interact harmoniously." Classes under or equal to 20 children, in comparison to ones over 25, have been found to lead to better learning attitudes, different and varied instructional practices, higher teacher satisfaction and morale, and, most importantly, higher achievement scores. As was said some years ago in the National Day Care Study, the size of group in which the child spends the most time makes an incredible difference in the quality of education and development (Weinstein, 1979; Bourke, 1986).

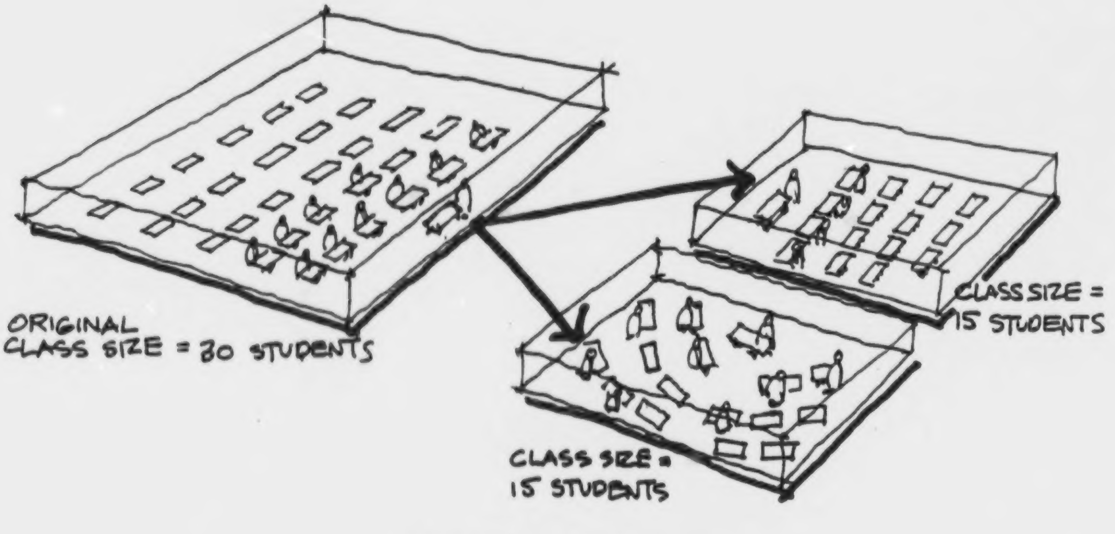

Figure 6.15. Small classrooms.

16. Variety of Learning Spaces

Interesting ecological research was completed a few years ago by David Berliner at the University of Arizona on the activity structures and patterns of children in elementary schools (Berliner, 1983). A taxonomy and description of 11 activity structures was derived from observations of over 1200 activity patterns in elementary classrooms. The implication of this research for architecture is the necessity of the creation of settings appropriate for (we might say "synomorphic" with) the activity structures. Allsopp (1991) and other commentators have similarly called for the provision of a variety of learning/teaching areas throughout a classroom and/or school. He suggested that a prototypical elementary classroom has three teaching areas: a flexible traditional main area, a "wet" area for occasional art or science, and a cozy corner, sometimes a loft or window seat area for more quiet study or one-on-one teaching. Berliner's research on what actually goes on in classrooms, however, points out the need for a number of additional activity areas for group reading, what he called "seatwork," one-way, two-way, and mediated presentations, silent reading, construction, games, free play, transition activities, and housekeeping activities.

Several examples of schools with a rich variety of activity areas appear in the architectural press. Several schools in Alberta, as well as ones premiated in the annual awards program of *American School & University* illustrate examples of a reading pit within a classroom, lofts and sunken story pits to give a sense of the variety of built-in spaces possible in a classroom setting, a story-telling amphitheater, electronic library carrels, etc.

As with the above pattern, the prototypical designs we will show in Chapter 7 will illustrate the necessity of the creation of settings appropriate for ("synomorphic" with) learning activity structures (Berliner, 1983). Provision for a variety of learning/teaching areas throughout a classroom and/or school. A prototypical elementary classroom may need three teaching areas: a flexible traditional main area, a "wet" area for occasional art or science, and a cozy corner, sometimes a loft or window seat area for more quiet study or one-on-one teaching. Need also for a number of additional activity areas for group reading, what he called "seatwork," one-way, two-way, and mediated presentations (Allsopp, 1991). All of these are important ways of creating a variety of learning places.

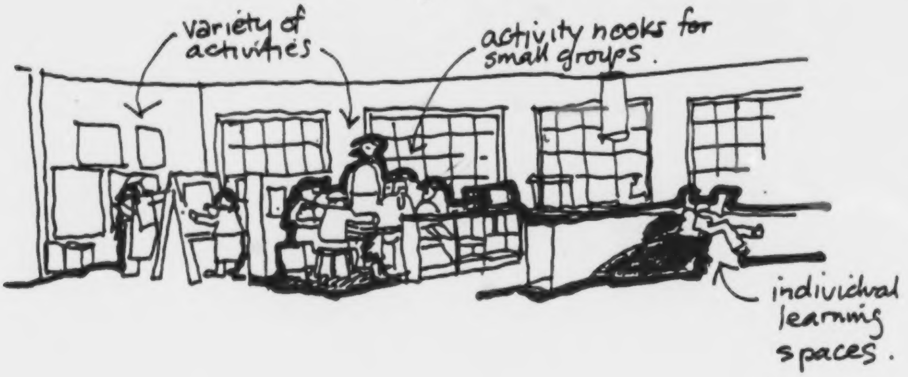
variety of activities
activity nooks for small groups.
individual learning spaces.

Figure 6.16. Variety of learning spaces.

17. Well-Defined Activity Pockets

Concordant with the notion of a Variety of Activity Areas is the architectural definition of these areas. Research conducted out of our Center has discovered that architecturally well-defined behavior settings (in contrast with partially and poorly articulated settings) contribute to significantly greater degree of engagement with learning activities, more teacher involvement with children, less teacher interruptions, and more exploratory behavior, social interaction, and cooperative behaviors among the children (Moore, 1986). Other research on classroom design has found that smaller clusters lead to increased use of learning materials (Weinstein, 1982), to increased substantive, content questions (Evans & Lovell, 1979), less non-task-oriented movement, less loud conversations, longer attention spans, and overall greater satisfaction. Sound absorbing partitions used to create Well-Defined Activity Pockets redirect traffic, demarcate class boundaries, and create small areas for privacy (Evans & Lovell, 1979).

Well-Defined Activity Pockets is a clear EB issue with considerably supporting research that many designers have picked up on with lecture pits, lofts, well-articulated activity nooks, and various other measures to isolate noise, dirt, and congestion from the primary learning centers.

The architectural definition of learning areas. Architecturally well-defined behavior settings contribute to significantly greater degree of engagement with learning activities, more teacher involvement with children, less teacher interruptions, and more exploratory behavior, social interaction, and cooperative behaviors among children (Moore, 1986). Smaller clusters lead to increased use of learning materials, to increased substantive, content questions, less non-task-oriented movement, less loud conversations, longer attention spans, and overall greater satisfaction (Weinstein, 1982; Evans & Lovell, 1979). How?--sound absorbing partitions, small areas for privacy, lecture pits, lofts, well-articulated activity nooks.

Secluded study spaces within classrooms are also important to students' development, and have been found empirically to be related to performance. Creating small learning centers within classrooms reduces classroom visual and auditory interruptions, makes learning materials more accessible, increases privacy, and leads to more questions asked by students. A study some time ago in the 1982 *Elementary School Journal* reported that structured reading areas significantly increase literature use by students. Some of our own research, reported in the *Journal of Environmental Psychology,* has also shown that for preschool children attention span is longer in architecturally well-defined activity settings within classrooms than it is in totally open classrooms.

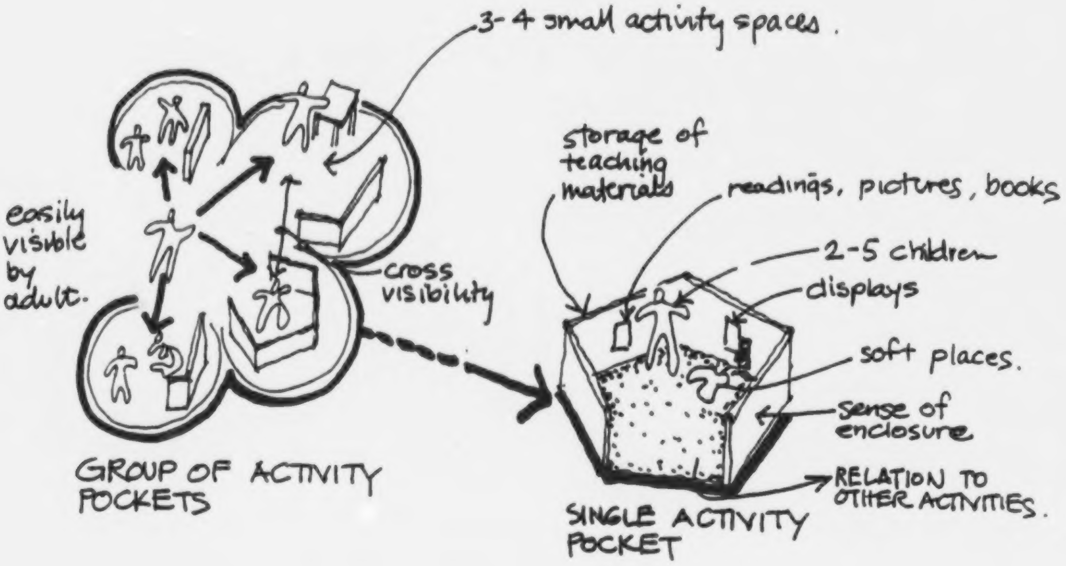
3-4 small activity spaces.
easily visible by adult.
cross visibility
GROUP OF ACTIVITY POCKETS
storage of teaching materials
readings, pictures, books
2-5 children
displays
soft places.
sense of enclosure
RELATION TO OTHER ACTIVITIES.
SINGLE ACTIVITY POCKET

Figure 6.17. Well-defined activity pockets.

18. Table Groups

"There is now considerable evidence that students working in small cooperative groups can master material better than can students working on their own" (Slavin, as cited in Fiske, 1991). This pattern architecturally articulates the Koln-Holweide model (Fiske, op. cit.), and the model of several reform schools around the country as part of the "smart classroom": multi-age grouping, children working in cooperative groups, teacher-as-coach and student-as-worker, all in cooperative table groups.

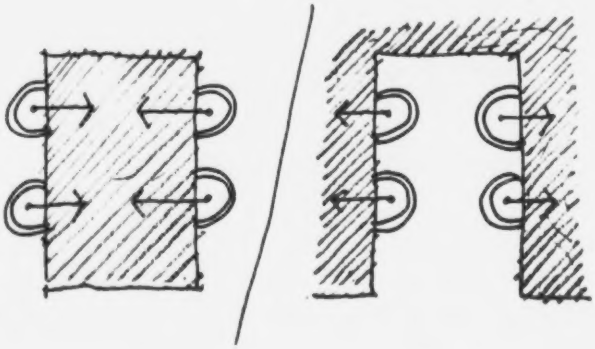

Figure 6.18. Table groups.

19. Nested Classroom Groupings

This pattern further supports individual study and activity, table groups, and large-group instruction, all in the same "smart classroom" (e.g., California Department of Education, 1990).

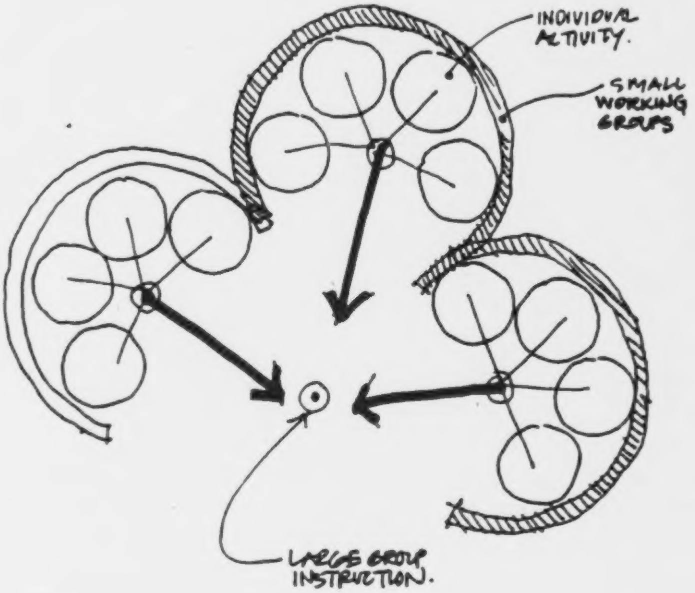

Figure 6.19. Nested classroom groupings.

20. Portfolio Process Studio

Howard Gardner argues that people have at least seven interwoven intelligences (Gardner, 1983). As schools move beyond traditional testing, one model is the "portfolio," authentic testing not only of product but also of process, what one has learned, and how they can apply it to real-life situations. Ted Sizer refers to student "exhibitions." The central architectural notion is the provision of appropriate space for working on portfolios, and exhibiting them, including but not limited to A/V studio, dance and performance studio, individual project work space, large open project tables, a gallery to display work, a staging area.

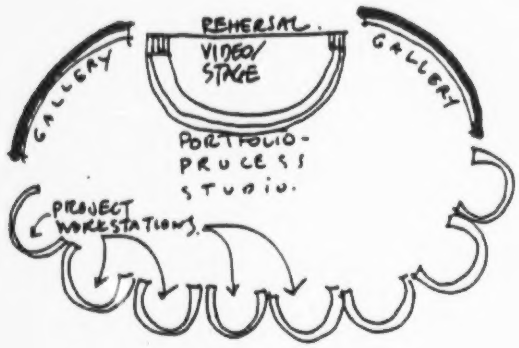
REHEARSAL.
VIDEO/
STAGE
GALLERY
GALLERY
PORTFOLIO-
PROCESS
STUDIO.
PROJECT
WORKSTATIONS.

Figure 6.20. Portfolio process studio.

21. Administration in the Mainstream

Shared decision making, the principal as leader and "facilitator," remaining close to the day-to-day functions of the classroom, to the students, to the teachers all argue for administration to be in the mainstream of the action, not isolated or removed in an "administrative wing." Some efficiency is sacrificed in the service of communication; administrative functions can even be separated into two mini-administrations in the mainstream, in the core of each house.

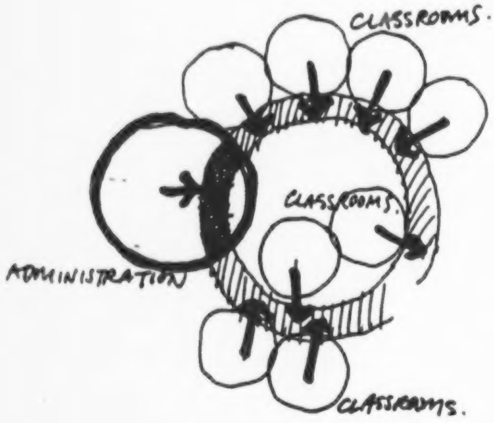
CLASSROOMS.
CLASSROOMS.
ADMINISTRATION
CLASSROOMS.

Figure 6.21. Administration in the mainstream.

22. Cluster of Teacher Offices

A new professionalism needs to be allowed to arise among our nation's teachers. If we believe that teachers should be involved not only in direct classroom teaching, but also in selecting textbooks and other aspects of shared decision making, then we must recognize their need for quality, private working space with telephones, fax machines, computer terminals, etc., all networked throughout the school and maybe the district. To support the idea of shared decision making, and a community of learning, not isolated teachers with isolated classrooms, these offices may be clustered and share a common seminar space, meeting room, staff back-stage.

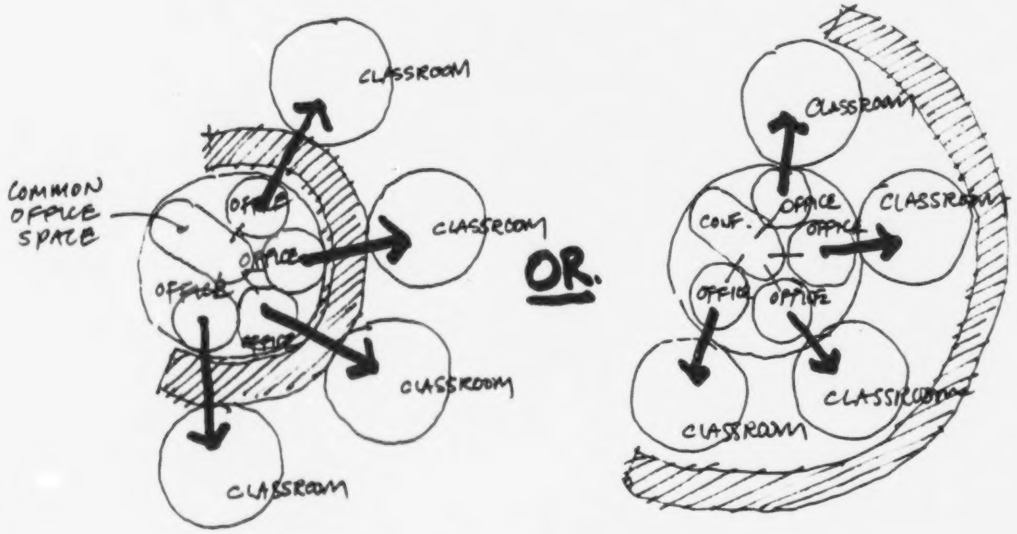
CLASSROOM
COMMON OFFICE SPACE
OFFICE
OFFICE
OFFICE
OFFICE
CLASSROOM
CLASSROOM
CLASSROOM
OR.
CLASSROOM
CONF.
OFFICE
OFFICE
CLASSROOM
OFFICE
OFFICE
CLASSROOM
CLASSROOM

Figure 6.22. Cluster of teacher offices.

23. Indoor-Outdoor Transition Spaces

A particular type of Well-Defined Activity Space is Indoor-Outdoor Transition Spaces. In earlier work, for younger, preschool children, we have called this pattern Porches and Decks as Activity Spaces. While the idea is similar, the scale and size must necessarily be different for older children. Post-occupancy evaluations we conducted in the mid-1970s found how important these transitional spaces are for educational programs that like to use the outdoor environment not only as a place for recess (the old Germanic educational idea of burning off energy before studying) but also as a laboratory for learning.

The basic architectural notion is that elements of the building reach out into outdoor spaces and create an additional transition space for class activities. An example published in the *Architects' Journal* (1990, *192*(6), 13) shows a gently pitched roof with a wide "eyebrow" for undercover teaching in slightly inclement weather (outdoor teaching is a tradition of this progressive English school). Other examples include a timber board walk beneath a fabric canopy to link the classroom units and double as an external teaching area or shaded loggias formed at each end of the building which can be used as outdoor project spaces ("Appraisal" by David Jenkins in the *Architects' Journal*, 1990, *192*(7), 40-55).

The importance of transitional spaces for educational programs that use the outdoor environment not only as a place for recess (the old educational idea of burning off energy before studying) but also as a laboratory for learning. Outdoor teaching as a tradition of many progressive English schools. Ways schools have done it: Elements of the building can reach out into outdoor spaces and create an additional space for class activities. A gently pitched roof with a wide "eyebrow" for undercover teaching in slightly inclement weather. A timber board walk beneath a fabric canopy to link classroom clusters and double as an external teaching area. Shaded loggias formed at each end of the building which can be used as outdoor project spaces.

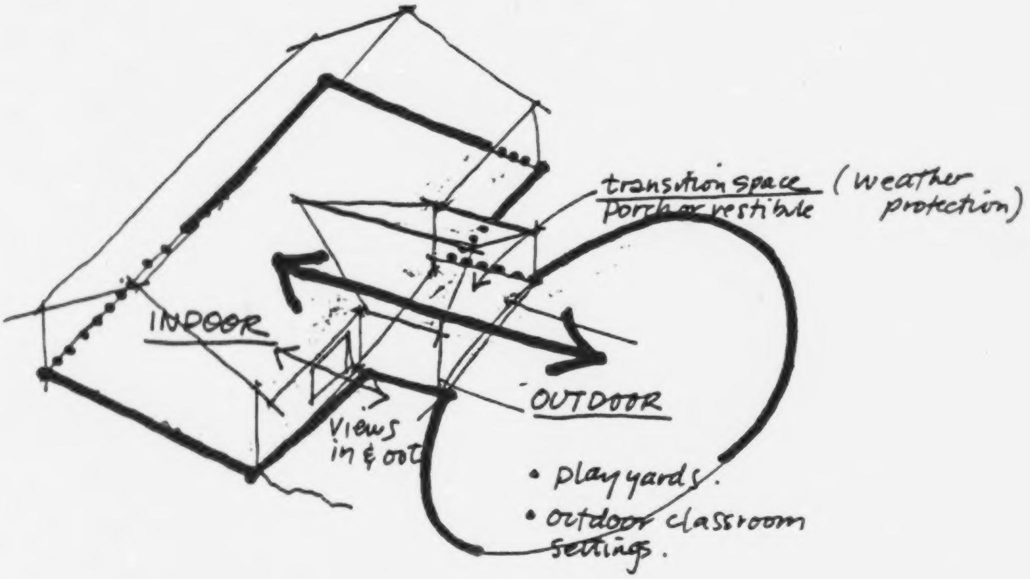

Figure 6.23. Indoor-outdoor transition spaces.

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24. User-Friendly / Child-Centered Aesthetics and Scale

There is some evidence, though limited, that soft classrooms are related to higher levels of voluntary participation, and that overall aesthetic quality in educational facilities is related to students' task persistence. No one would doubt that child-scaled and user-friendly spaces are more pleasant for children. As Doxiadis once said, "What would the city look like if it were designed from the child's point of view?"

Schools over the past few years have been characterized by attention to detail and thoughtfulness of design. Efforts have been made to minimize the institutional character with small dining rooms, small bathrooms adjacent to classrooms, and, in general, the exploration of friendly, less institutional, and distinctive personalities to buildings. Other examples of this user-friendly aesthetic appeal include the creation and use of natural materials and colors (e.g., cedar channel siding), extensive landscaping coming right up to the school, interesting and engaging spaces, forms, textures, etc., child scaled spaces, rounded corners and Waldorfian angles, and the use of friendly symbols. In one example, a school complex centers on an old farm pond for exploration. There are many examples of small, child-scaled spaces using common residential wood construction and the vernacular of rural areas and farms, with views scaled to children and even one case of fossils embedded in accent tiles in a lobby floor. An article on user-friendly school additions published in *Architecture* (1989, *78*(5)) discusses design inspired by forms and allusions to "storybook castles," considered user-friendly in the sense that the architecture is intended to accommodate the "expanding psyches" of children and fire their imaginations. All of these are examples of User-Friendly/Child-Centered Aesthetics and Scale.

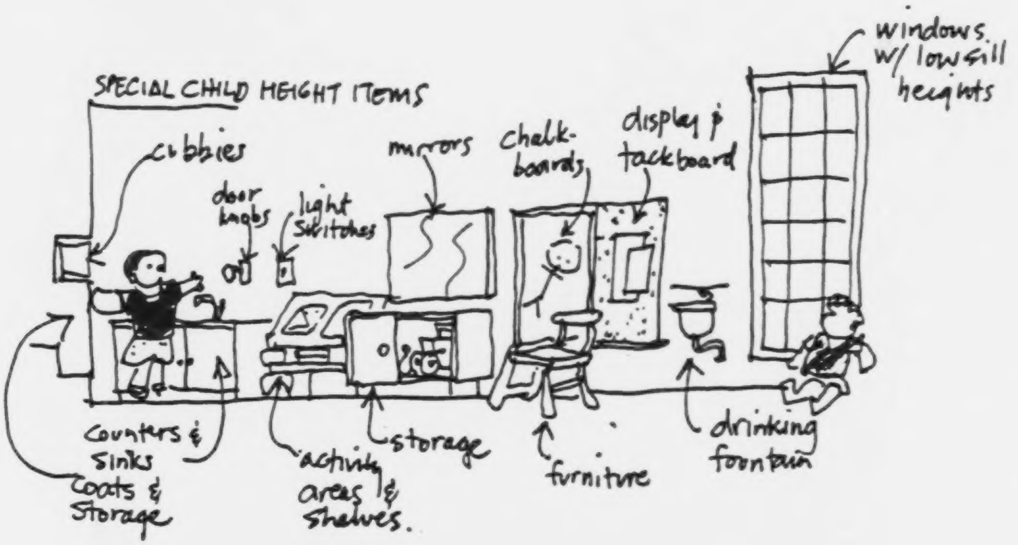
SPECIAL CHILD HEIGHT ITEMS
cubbies
door knobs
light switches
mirrors
Chalk-boards
display & tackboard
windows w/ low sill heights
counters & sinks
coats & storage
activity areas & shelves.
storage
furniture
drinking fountain

Figure 6.24. User-friendly / child-centered aesthetics and scale.

Critical Technical Details

25. Controlled Indoor Climate

There is a range of human factors and physiological research on the effects of various indoor climatic factors (temperature, humidity, and air movement) on student's performance. The findings, not surprisingly, are that levels of comfort, attention span, level of productivity, performance, an overall achievement declines as temperature or humidity increase (King & Marans, 1979). Indoor climatic factors are a major problem in many schools.

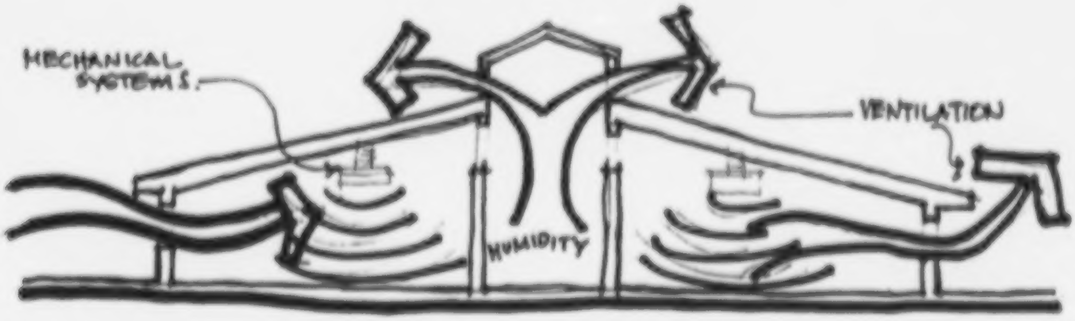

Figure 6.25. Controlled indoor climate.

26. Appropriate Acoustics

Noise has been extensively studied in all types of educational environments. The overwhelming finding is that teachers complain about noise more than do students, that students with disability are more affected by noisy environments (King & Marans, 1979), but that there are no demonstrable effects of *short-term* noise from inside or outside the classroom on average students on speed or accuracy of performance. On the other hand, there is incontrovertible evidence that there are significant and profound effects of *external, long-term noise* on lost time, lower reading test scores, greater distraction, lack of task persistence, and higher blood pressure.

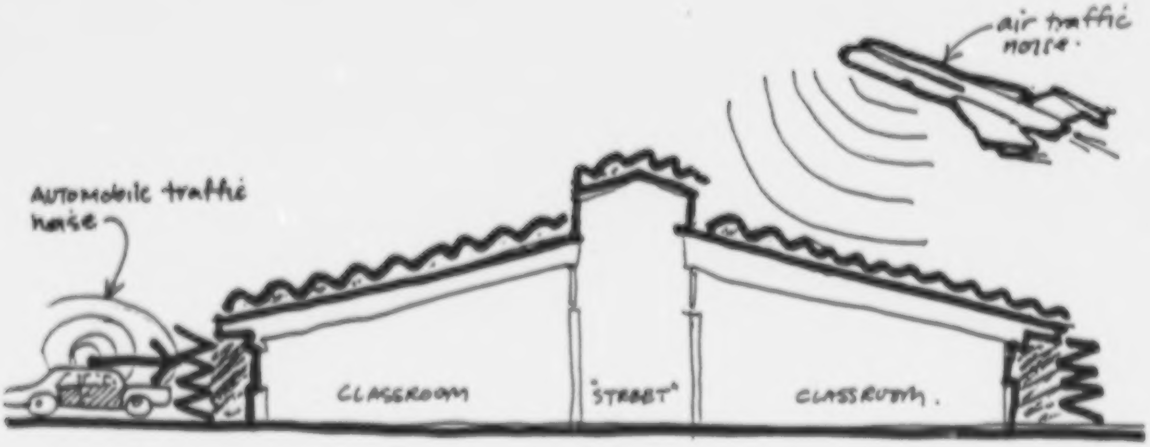
air traffic noise.
AUTOMOBILE traffic noise
CLASSROOM
"STREET"
CLASSROOM.

Figure 6.26. Appropriate acoustics.

27. Natural/Full-Spectrum Lighting

Human factors and physiological research has been conducted on lighting, and in particular on the possible effects of windowless classrooms and fluorescent lighting in schools. The predominant finding from studies on windows versus windowless schools is that students have both positive and negative attitudes toward windowless schools, but the negative attitudes increase over time, whereas teachers, for the most part, have positive attitudes, believing that windowless schools cut down on distractions. The empirical evidence is that there is no behavioral impact one way or the other on performance (King & Marans, 1979). There is some evidence (though criticized and conclusions must be taken as tentative) that fluorescent lighting increases stress and hyperactivity (King & Marans, 1979) in comparison with full spectrum or incandescent lighting and natural light.

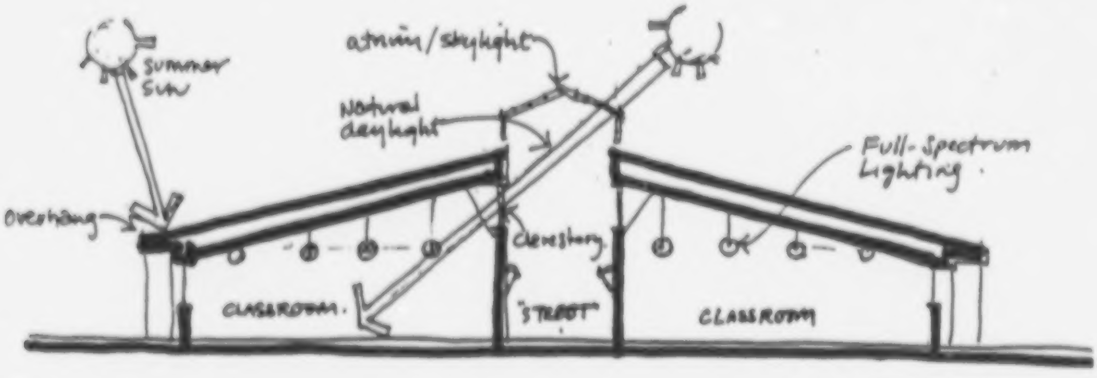
summer sun
atrium/skylight
Natural daylight
Full-Spectrum Lighting.
Overhang
Clerestory
CLASSROOM.
"STREET"
CLASSROOM

Figure 6.27. Natural/full-spectrum lighting.

Origins and Status of Design Patterns

The table below presents the "origins and status" of all 27 patterns generated to date. First the table identifies the origins of each pattern by referencing the disciplinary sources which are the basis for the pattern (the architectural, educational reform, or EB research literatures, and/or the practical experience of educators). Each pattern must be considered a working hypothesis, subject to further test and refutation or corroboration. In the meantime, these working hypotheses are offered for consideration for implementation in schools. The table also reports overall confidence ratings in the validity of each pattern based largely on the strength of its current support from these three sources.

Table 6.1. Patterns: Origins and status

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Planning Issues					
And the Winning School is...Smaller	○	●	●	●	•••
School as a Community Center/ Neighbors of Community Activities	◒	●	○	○	••
Contextual Compatibility	◒	○	○	○	•
Safe Location	○	○	◒	○	••
Building Organizing Principles					
Campus-Plan Concept/ Schools within Schools	◒	◒	◒	○	••
Compact Building Form	●	○	○	○	•
Building Core/Community Forum	◒	◒	○	○	•
Team Suites/Clusters of Classrooms	◒	●	○	◒	•••
Open Space	●	○	○	○	•
Modified Open Space	○	○	◒	○	••
Supervisable Circulation Paths	●	○	○	●	••
Flexible/Adaptable Learning Facility	●	●	○	●	••
Home as a Template for School	◒	○	○	○	•
Design Diversity	◒	○	○	○	•
Character of Individual Spaces					
Small Classrooms	○	●	●	●	•••
Variety of Learning Centers	○	◒	○	◒	••
Well-Defined Activity Areas	○	○	◒	○	••
Table Groups	○	◒	○	◒	••
Nested Classroom Groupings	○	◒	○	○	••
Portfolio Process Studio	○	●	○	○	••
Administration in the Mainstream	○	◒	○	○	•
Cluster of Teacher Offices	◒	●	○	◒	••
Indoor-Outdoor Transition Spaces	◒	○	○	○	••
User-Friendly/Child-Centered Aesthetics and Scale	◒	◒	○	◒	••
Critical Technical Details					
Controlled Indoor Climate	●	○	◒	◒	•••
Appropriate Acoustics	●	○	◒	●	•••
Natural/Full-Spectrum Lighting	●	○	◒	◒	••

Key

Magnitude of Justification

●	Strong
◒	Some
○	None

Confidence Rating

•••	Very Confident
••	Moderately Confident
•	Slightly Confident

CHAPTER 7

PROTOTYPE DESIGNS FOR THE NEW AMERICAN SCHOOLHOUSE OF THE 21ST CENTURY[25]

Conducting empirical research. Review and interpretation of research. Translation into design patterns. Facility planning and programming. These are the building blocks of a research-based approach to educational facility design. But what might the "new American schoolhouse of the 21st century" look like?

We were invited and commissioned by the editors of *Agenda*, a Scholastic publication, to develop such a prototypical design, including annotated plans for a school of the future, essentially giving form to the issues raised in the above chapters and in discussions of educational reform. The core of the design is an attempt to respond to education restructuring by asking the fundamental question, what does it mean architecturally?

In the pages that follow is a conceptual design--not a blueprint--not to be followed slavishly and certainly not to be copied--but an idea of how the above patterns come together to create a building for restructured education based on both the EB research literature and the reform movement, and may begin to suggest some new ways of thinking about educational facilities. The conceptual design proceeds from small scale to larger urban scale. An attempt is made for each section to build on the previous section as the design unfolds.

Team Suite Plan

The first part of the prototype is what we call the "Team Suite Plan." It is based on the central notion of a cluster of classrooms and grew out of integrating eleven of the patterns, namely:

- Team Suites / Clusters of Classrooms. The classroom suite, sometimes called the "self-contained classroom community" or "the pod school." A series of small suites of interconnecting, inter-communicating classrooms and support facilities around central core functions.

- Small Classrooms. Classrooms under 20 children.

- Flexible/Adaptable Learning Facility. Flexible spaces, flexible classrooms of all types including project rooms and the "portfolio process studio."

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[25] An earlier version of this chapter was invited and commissioned by *Agenda*, published by Scholastic Press, Inc. The magazine, however, ceased publication before the article could be published.

- Table Groups. Multi-age grouping, children working in cooperative groups, with the teacher-as-coach and student-as-worker, students working in cooperative table groups.

- Nested Classroom Groupings. Support for individual study and activity, for table groups, and for large-group instruction, all in the same "smart classroom."

- Modified Open Space. A type of space division that resolves the dilemma between open and closed plan types and allows the best of both extremes while minimizing the problems of both--a mixture of several open areas with smaller, enclosed spaces.

- Variety of Learning Spaces. The creation of settings appropriate for ("synomorphic" with) learning activity structures--a variety of learning/teaching areas throughout a classroom and/or school--a prototypical elementary classroom may need three primary teaching areas: a flexible traditional main area, a "wet" area for occasional art or science, and a cozy corner, sometimes a loft or window seat area for more quiet study or one-on-one teaching--may need also a number of additional activity areas for group reading, "seatwork," one-way, two-way, and mediated presentations.

- Well-Defined Activity Pockets. Architecturally well-defined learning/activity settings--sound absorbing partitions, small areas for privacy, lecture pits, lofts, well-articulated activity nooks, etc.

- Portfolio Process Studio. The provision of appropriate space for working on portfolios, and exhibiting them, including but not limited to A/V studio, dance and performance studio, individual project work space, large open project tables, a gallery to display work, and a staging area.

- Cluster of Teacher Offices. Quality, private working space with telephones, fax machines, computer terminals, etc., all networked throughout the school and maybe the district--these offices clustered and sharing a common seminar space, meeting room, staff back-stage.

- User-Friendly/Child-Centered Aesthetics and Scale. The whole designed from the elementary child's point of view and size.

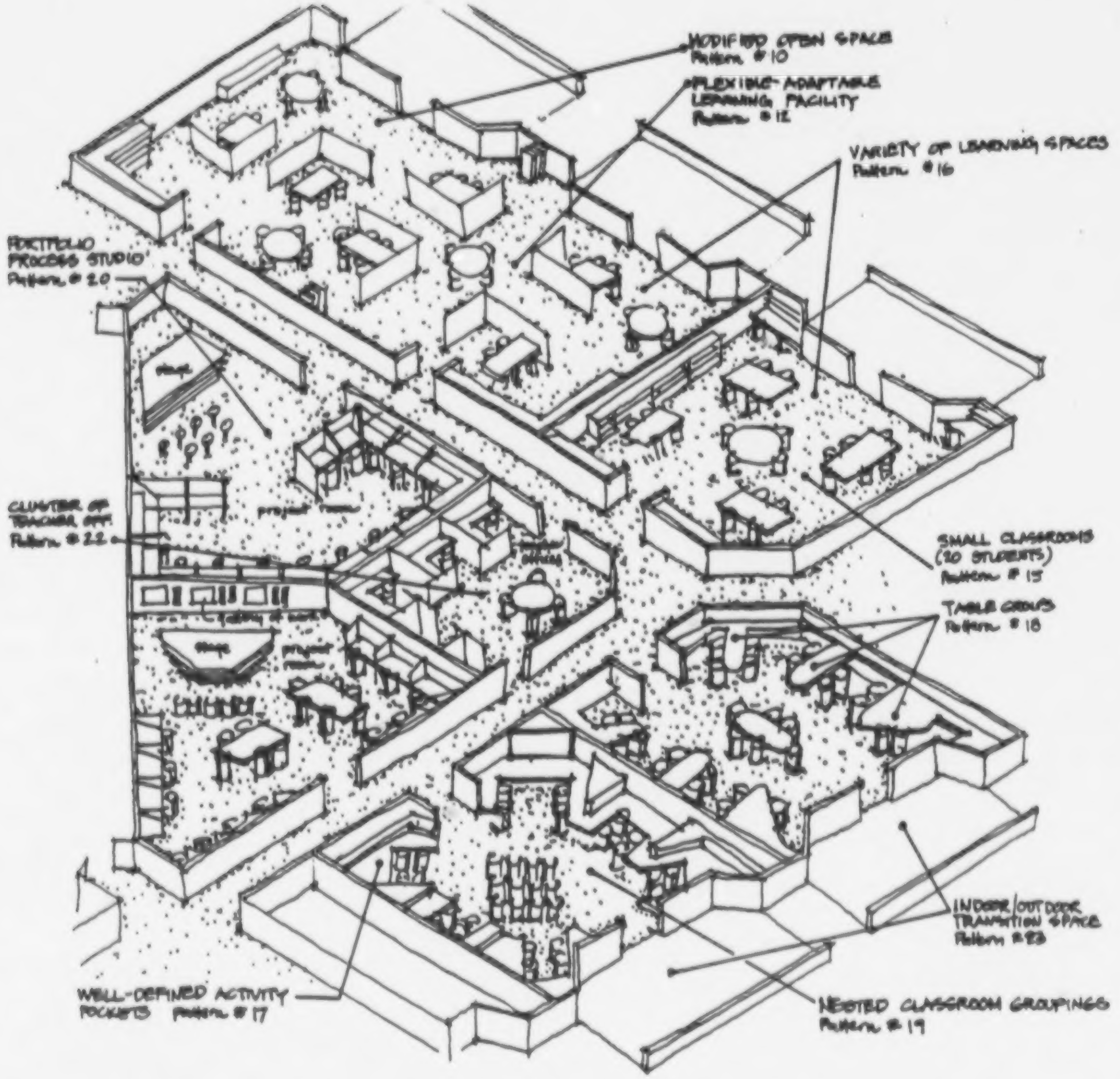
MODIFIED OPEN SPACE
Pattern #10
FLEXIBLE-ADAPTABLE
LEARNING FACILITY
Pattern #12
VARIETY OF LEARNING SPACES
Pattern #16
PORTFOLIO
PROCESS STUDIO
Pattern #20
CLUSTER OF
TEACHER OFF.
Pattern #22
SMALL CLASSROOMS
(20 STUDENTS)
Pattern #15
TABLE GROUPS
Pattern #18
INDOOR/OUTDOOR
TRANSITION SPACE
Pattern #23
NESTED CLASSROOM GROUPINGS
Pattern #19
WELL-DEFINED ACTIVITY
POCKETS Pattern #17

Figure 7.1. Prototype design for the new schoolhouse: Team suite / cluster of classrooms.

House Plan

The building block of the team suite/cluster of classrooms combines with other clusters to form what we call the "House Plan." A *house* is made up of two or more clusters, serving, ideally, 300 to 360 children, as shown in the accompanying drawing. Its design is further generated by an additional six patterns:

- Campus-Plan Concept/Schools within Schools. The village or campus-plan concept--a decentralized building plan--the idea of separated yet related schools-within-a-school, separated yet related administratively and architecturally, a series of academic wings or even separate "houses" (K-2, 3-5) for approximately 210 to 360 students each, each with its own commons and entrance, the resulting design successfully breaking down the scale of the building.

- Home as a Template for School. The home, rather than office or other institutional buildings, as the model or image for the school.

- Administration in the Mainstream. Administration to be in the mainstream of the action, not isolated or removed in an "administrative wing."

- Great Spaces. The possibility of centering the house on a great space, a central atrium or other common meeting place and symbolic heart to the house.

- Supervisable Circulation Paths. Clear circulation paths that connect activities and classrooms without disturbing them, and that are easily supervisable, with no hidden corners or out-of-the-way spaces.

- Indoor-Outdoor Transition Spaces. Transitional spaces between indoors and out--used as teaching/learning spaces--elements of the building can reach out into outdoor spaces and create an additional space for class activities, a gently pitched roof with a wide "eyebrow" for undercover teaching in slightly inclement weather, a timber board walk beneath a fabric canopy to link classroom clusters and double as an external teaching area, shaded loggias formed at each end of the building which can be used as outdoor project spaces, etc.

Campus Plan

Finally, in the third step, the houses become combined into an overall "Campus Plan," influenced by another seven critical patterns:

- And the Winning School is ... Smaller. Downsizing elementary schools to 500 to 600 pupils per school [our drawings show two schools for ca. 720 students].

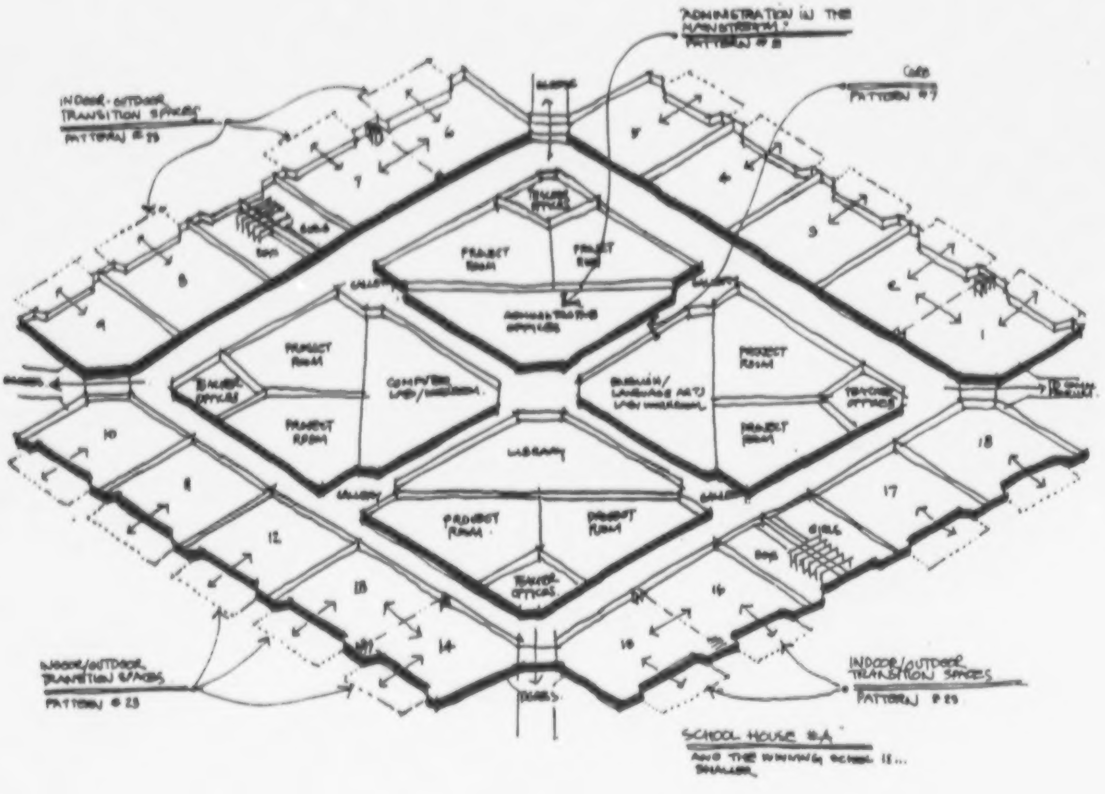
"ADMINISTRATION IN THE MAINSTREAM"
PATTERN # 8
INDOOR-OUTDOOR TRANSITION SPACES
PATTERN # 23
CAFE
PATTERN # 7
TEACHER OFFICES
PROJECT ROOM
PROJECT ROOM
ADMINISTRATIVE OFFICES
GALLERY
PROJECT ROOM
TEACHER OFFICES
COMPUTER LAB/CLASSROOM
PROJECT ROOM
ENGLISH/LANGUAGE ARTS LAB/CLASSROOM
PROJECT ROOM
TEACHER OFFICES
PROJECT ROOM
LIBRARY
PROJECT ROOM
PROJECT ROOM
TEACHER OFFICES
GIRLS
BOYS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
INDOOR/OUTDOOR TRANSITION SPACES
PATTERN # 23
INDOOR/OUTDOOR TRANSITION SPACES
PATTERN # 23
"SCHOOL HOUSE #A"
AND THE WINNING SCHOOL IS... SMALLER

Figure 7.2. Prototype design for the new schoolhouse: House plan.

- Safe Location. Location away from noxious elements, from dangerous areas, from high traffic streets, or at least well buffeted from all of these.

- School as a Community Center/Necklace of Community Activities. Integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and the school as a community hub--the creation of a "learning community" including but not limited to housing child care centers, continuing and job-training educational programs, youth programs, programs for parents and families, administration offices, social services, and facilities for community and town hall meetings--architecturally, the school may wrap around the community functions, as around a "town square," or the community functions can be a necklace around the school.

- Building Core/Community Forum. A shared community forum as the building core--including but not limited to such common-use spaces as the library, multi-purpose rooms, gallery--more fundamentally, a community forum for school-based management, for shared decision making, and other community functions (town hall meetings, etc.).

- Contextual Compatibility. Weaving the school visually into the community, using the local vernacular as the basis for visual and aesthetic design.

- Design Diversity. The creation of a diversity of design within the context of compatibility, e.g., different houses can be articulated architecturally so they are seen as being different houses, yet they remain as variations on a larger theme of the school as a whole, and remain contextually compatible with the surrounding community.

- Compact Building Form. Elimination of extraneous perturbations, bringing the building envelope into a compact form, in terms of plan and overall building massing.

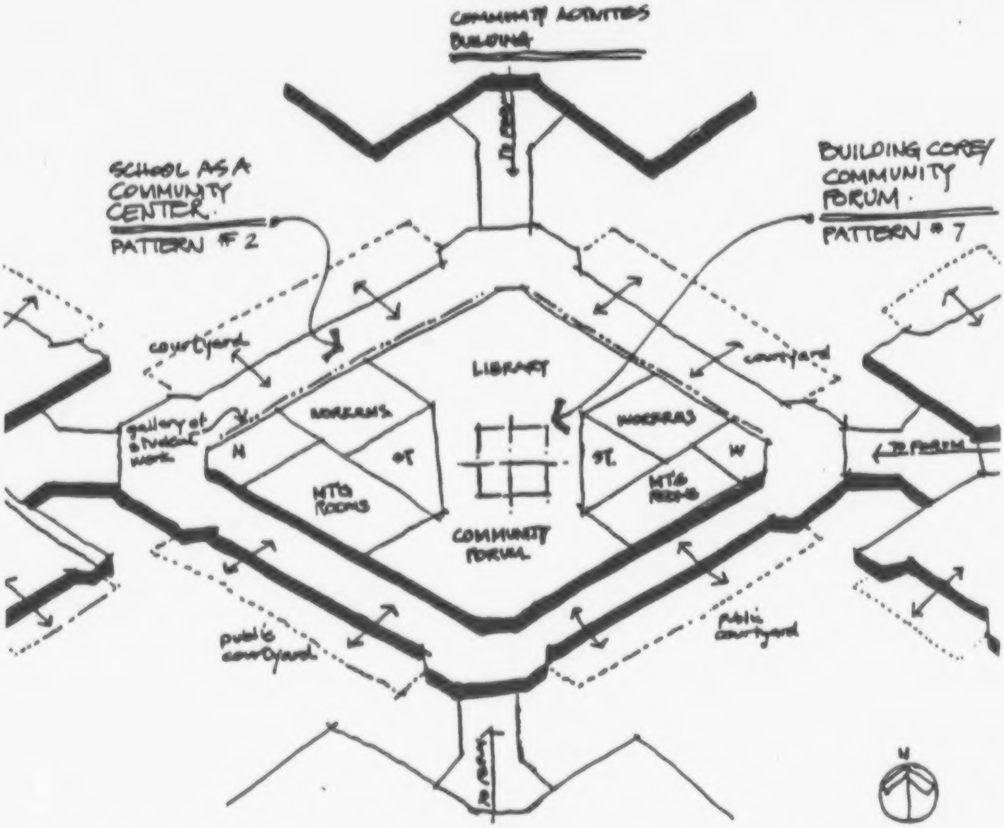
COMMUNITY ACTIVITIES BUILDING
SCHOOL AS A COMMUNITY CENTER.
PATTERN #2
BUILDING CORE/ COMMUNITY FORUM.
PATTERN #7
courtyard
courtyard
LIBRARY
gallery of student work
N
ST
MTG ROOMS
ST.
W
MTG ROOMS
COMMUNITY FORUM
TO FORUM
public courtyard
public courtyard
N

Figure 7.3. Community affairs building as the heart of the prototypical design.

There are two major variations on the campus plan. Alternative 1--strongly influenced by Campus-Plan Concept/Schools within Schools and by School as a Community Center/Necklace of Community Activities--shows a decentralized plan, suitable for a suburban or rural site. Alternative 2--more influenced by Compact Building Form--shows a stacked plan, suitable for an urban site.

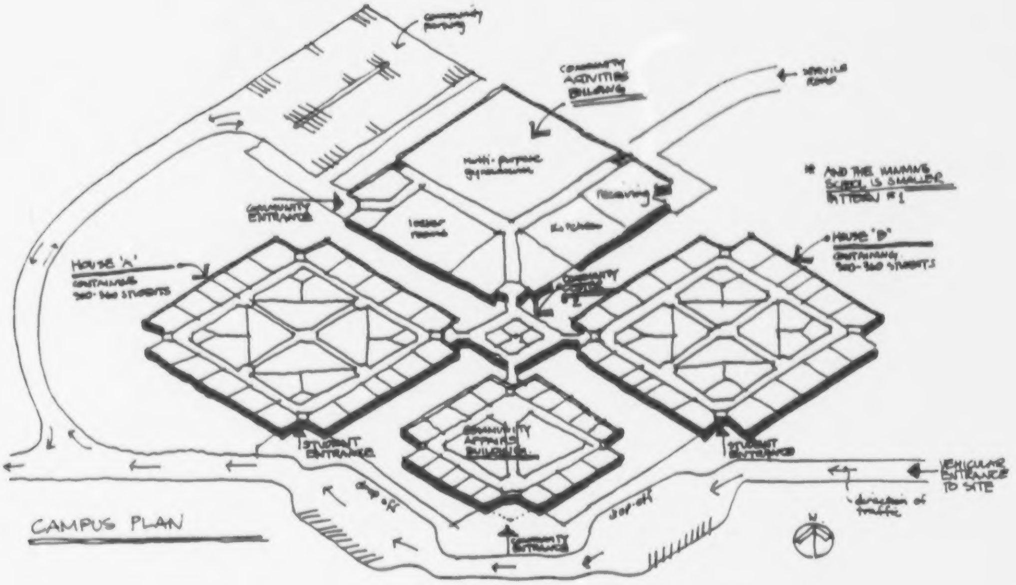
community parking
COMMUNITY ACTIVITIES BUILDING
SERVICE ROAD
multi-purpose gymnasium
Receiving
COMMUNITY ENTRANCE
locker rooms
kitchen
HOUSE 'A'
CONTAINING 300-360 STUDENTS
HOUSE 'B'
CONTAINING 300-360 STUDENTS
COMMUNITY AFFAIRS BUILDING
STUDENT ENTRANCE
STUDENT ENTRANCE
VEHICULAR ENTRANCE TO SITE
direction of traffic
drop off
drop off
COMMUNITY ENTRANCE
CAMPUS PLAN
N

Figure 7.4. Campus plan--Alternative 1: Decentralized plan.

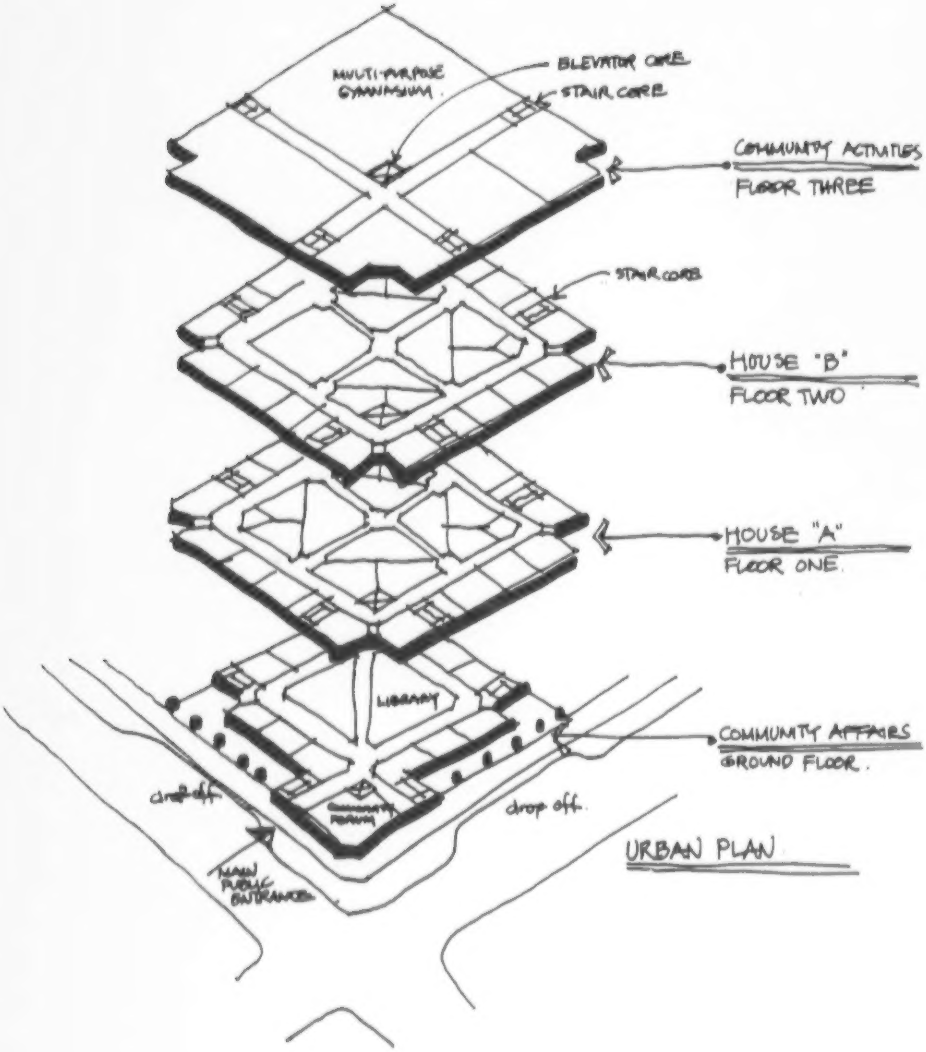
MULTI-PURPOSE GYMNASIUM.
ELEVATOR CORE
STAIR CORE
COMMUNITY ACTIVITIES
FLOOR THREE
STAIR CORE
HOUSE "B"
FLOOR TWO
HOUSE "A"
FLOOR ONE.
LIBRARY
COMMUNITY AFFAIRS
GROUND FLOOR.
drop off
COMMUNITY FORUM
drop off.
MAIN PUBLIC ENTRANCE
URBAN PLAN

Figure 7.5. Campus plan--Alternative 2: Stacked plan.

CHAPTER 8

EDUCATIONAL FACILITY PLANNING: A CRITIQUE AND RECONCEPTUALIZATION OF CURRENT EDUCATIONAL FACILITY PLANNING MODELS[26]

This chapter argues that current educational facility planning models in the architectural and educational literature are at most, partially successful in their aim of guiding educational planners through the facility planning process. In addition, they fail to provide a comprehensive accounting of the social, economic and political realities of either the circumstances surrounding the planning effort or the nature of the educational system. By not completely representing these realities, planning models leave educational administrators acting on the basis of simplified and incorrect assumptions about the nature of the process. As a result, administrative decision-makers are ill-prepared to deal with the inevitable political conflicts and miscommunication: facilities are often under-funded; projects are inefficiently designed, not taking user needs into full consideration; and once facilities are occupied, they are often haphazardly and hastily staffed, allowing problems to fester throughout the life of the building. Given the increasing pace of current school reform and change in the educational system, new conceptualizations of the facility planning process are greatly needed in order to successfully guide educational organizations in their efforts to accommodate this change.

This chapter will focus on the earlier stages of the facility development process,[27] that of feasibility and planning. Issues covered during these phases in the process have the greatest impact and influence on the nature and quality of the subsequent stages in the process and therefore, deserve special attention. An existing model of the educational facility planning process will be reviewed followed by a critique of the model. A reconceptualization of the planning model is then developed which addresses the issues raised in the critique, and finally, some conclusions are offered.

Existing Models of the Educational Facility Planning Process

Current models of the educational facility planning process are based on the practical experiences of educational planning and design professionals and on those professionals' notions of how the process should be structured and organized (Graves, 1993; Ingalls, 1986; Vasilakis, 1990). Educational facilities master planning has been defined as "a process to determine the educational needs of a school district and the facilities needed to support those educational needs, both now and in the future" (Vasilakis, 1990, p. 26). The process allows a school district to examine its educational goals and philosophies, educational teaching methods and its facility resources and needs, as well as allowing the district to explore alternative solutions.

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[26] An earlier version of this chapter was presented as an unpublished seminar paper by Jeffery A. Lackney entitled "Current educational facility planning models: A critique and a reconceptualization," Department of Architecture, University of Wisconsin-Milwaukee, May 1993. A further exploration of the reconceptualized educational facility planning model will be presented in a companion paper (in preparation).

[27] The educational facility development process as defined here includes the sub-processes of feasibility, planning, programming, design, construction, occupancy, facility management (operations and maintenance), post-occupancy evaluation, and redesign.

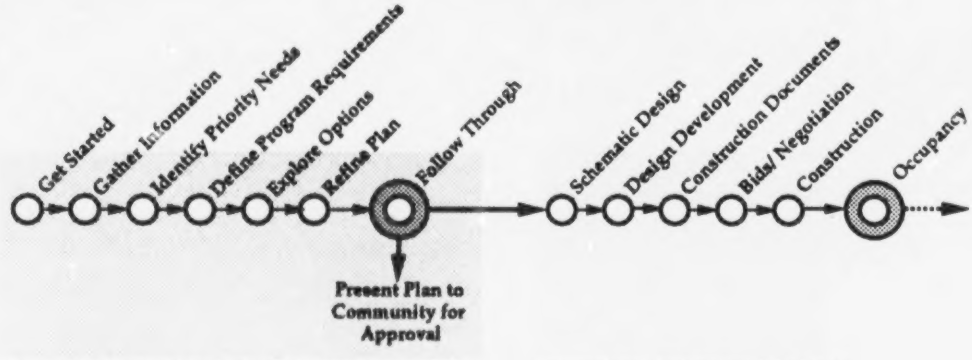
It is generally agreed that planning of school facilities should be done within the framework of a well-developed, long-range construction and educational program plan. This is determined by a thorough study of, among other factors, community services; financial ability and economic base of the community; construction priorities; enrollment and population trends and projections; and the nature of the educational programs to be housed. Such advanced planning, it is argued, can eliminate costly errors in construction and minimize the intervals between the need for and acquisition of necessary physical facilities (Ingalls, 1986).

The most complete and current descriptive model of the educational facility process has been documented by Ben Graves (1993), a former project director and much of the heart-and-soul of Educational Facilities Laboratories (EFL). He described the process in terms of the roles and responsibilities of the architect and school administrator in planning and designing the school. The model offers a cogent summary of acceptable educational facility planning practice conducted over the last 30 years in school districts across the country.

Graves first reviewed the Educational Facilities Laboratory's seven stages needed to plan a building project (see Figure 8.1): (1) *get started:* defining goals and planning to plan; (2) *gather information:* enrollment projections, capacity, and utilization analysis of existing facilities; (3) *identify priority needs*: review information-base and involve the community; (4) *define program requirements:* attention to physical needs and preparation of educational specifications; (5) *explore options:* consistent with the community's educational goals; (6) *refine the plan:* determine feasibility, cost, and phasing; and (7) *follow through:* presentation of plan by experts to the community for approval.

Special emphasis is given to the effective uses of the educational consultant, writing of comprehensive educational specifications, selection of the architect, working with school boards, learning the community perspective and gaining the child's perspective. In addition, Graves stresses the importance of the effects of technology on school design, as well as furniture and equipment, modernization, specialized spaces and security issues.

Graves also presented the stages of the conventional architectural design process that follow the educational planning process: *pre-design planning* or *programming, schematic design, design development, construction document preparation, bidding,* and *construction.* He completed his description of the educational facility planning process by outlining seven characteristics which successful planning processes have in common: (1) they have a clearly stated program, (2) there is a give and take from participant "experts" in the process, (3) plenty of time is taken for planning, (4) involvement of community in the planning process is promoted to gain acceptance and support for the project, (5) training sessions on the use of the building are implemented, (6) post-occupancy evaluations are conducted, and (7) maintenance and repair of facilities are regularly completed as part of a long-term maintenance program.


Get Started
Gather Information
Identify Priority Needs
Define Program Requirements
Explore Options
Refine Plan
Follow Through
Present Plan to Community for Approval
Schematic Design
Design Development
Construction Documents
Bids/ Negotiation
Construction
Occupancy

Current Educational Facilities Planning Process (EFL)

Conventional Architectural Building Delivery Process (AIA)

Figure 8.1 The current educational facility planning model.

In general, the purpose of this model is to represent the most critical elements or components of the facility planning process. The argument presented in this chapter is that the current educational facility planning model summarized above, does not fully capture the reality of the planning process, and thereby is not as effective as it could be in guiding educational administrators and planning consultants through the process.

A Critique of the Current Model

The current planning model as described by Graves (1993) is by its very nature normative, and espouses the rationalistic tradition in planning theory. The model is normative in that it presents how the planning process *should be,* not *how it is.* It is a rational model in that it views people as a utility and defines human relations in instrumental terms, and it assumes a sequential, observable cycle that includes setting goals, determining objectives, making plans, implementing the plans, and reviewing the results (Adams, 1991). Admittedly, proponents of the current model might agree that the model describes what should happen in the planning process and that if the procedures set forth are not followed the process could fail. However, if in fact the goal of this model is to guide administrators through a complex process, why has the current model failed, in many cases, to guide? The answer argued in this chapter is that by not fully accounting for the social, political and economic realities inherent in the planning process, administrative decision-makers often abandon and/or ignore the important guidelines in favor of ad hoc planning.

Status of Existing School Infrastructure

One approach to evaluating a process is to analyze the products produced by that process. While everything which has gone wrong in the design and management of educational facilities over the past 30 years cannot be faulted solely on the initial planning process, or the model that it is based on, historical evidence can highlight aspects of the process which could warrant improvement or reconceptualization.

In 1989, the Education Writers' Association released a study of the condition of school buildings which found that 49% of all schools nationwide were built in the 1950 and 1960s primarily to meet the increasing demand for schools for baby-boom children (as reported by Walker, 1993). Many of these buildings were constructed of cheaper building materials, with flat roofs, and built to last no more than 20 years without some form of major repair. In addition, these buildings although often claimed by their designers to provide flexible space, have not met this standard. The study also found that 21% of buildings nationally are more than 50 years old and are located primarily in the inner-cities. These buildings have been neglected and are in need of major repair and renovation due to short-sighted maintenance and repair policies. The most alarming finding of the study was the fact that over 25% of the buildings were considered inadequate for educational use by state facility directors due to serious maintenance and repair needs, environmental hazards, and overcrowding. Close to another 33% of these buildings will be at capacity due to population growth and other educational demands in the near future.

With all that is going wrong with the existing school infrastructure in this country, what has been the response by the educational community and the public-at-large? Again, according to the study conducted by the Education Writers' Association, the US school infrastructure has been virtually ignored for the past two decades due to high, ongoing investment costs, a declining tax base and declining enrollments. Ironically, school districts over the past several years have been experiencing new growth in enrollments, and in new programs and services such as the year-round school programs, extended school hours of operation, daycare, and provisions for new program requirements in math and science.

The current model of the educational facility planning process may adequately address immediate needs of users, but it clearly has not accounted for such long-term building life-cycle issues as repair and maintenance policies and changes in use of facilities due to educationalt program changes. The plans which called for flexible space planning and design have not been as effective in addressing these program changes as once assumed.

Collaboration and School Reform: A Case Study of the Milwaukee Public Schools

The current model of the educational facility process was originally developed during the dramatic educational system reforms of the 1960s in which state involvement in school finance and governance expanded to include the planning of facilities. Many educators believe that "state legislatures, regulatory agencies and product manufacturers have had more effect on school design and equipment than educators themselves."[28] Contrary to the current model's call for participation by educators in the planning and design process, few educators have traditionally been involved in the process which has been consistently controlled by architects and by educational administrators and planners, both state and local.

The case of the planning of three new middle schools in the Milwaukee Public Schools (MPS) provides an example of the manner in which "collaboration" is realized in the current facility planning model. As a result of an offer of a development package by a local developer, MPS initiated the planning of two new middle schools to be housed in existing abandoned structures in the city. A relatively comprehensive collaborative planning and design process had been previously completed in the creation of a new middle school. The middle school was considered to be a model implementation of MPS's middle school policy established in 1979. The two new middle schools included in the development package were to be based on the planning concepts derived from the earlier model school. The collaborative planning process was drastically shortened, involving the school board, central administration, affected business community representatives, the architect, and the developer. Neither school design involved educators or children in the process. The staff for each school were not even selected until well into the process. MPS facility planners and architects assumed that planning decisions established in an earlier project had universal applicability and that the new school designs required only minimal adaptation even though the siting and configuration of both existing structures were completely different.

With a new wave of school reform promising to "restructure" the educational system, comes the possibility of restructuring the conventional planning process to embrace a more collaborative process advocated by the current model. However, according to Goldberg and Bee (1991) even with the advent of school-based management and shared decision-making, little has changed in the process.

Politics and the Acquisition of Fiscal Resources

The most severe critique against the current planning model is that it does not take into account the complexities and importance connected with the acquisition of fiscal resources without which the building program can never become a reality. Mitchell, Marshall, and Wirt (1985) found that of seven major policy mechanisms, school finance dominates policy-making while building and facility policy rank last. State political culture, informal processes, partisan politics, fiscal environment, and history and tradition are more powerful determinants of facility design and planning decisions than organizational factors.

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[28] Harold Hawkins, The Interface Project, Texas A&M University, quoted in *Education Week*, February 21, 1990.

The findings of Mitchell et al. are consistent with the position taken by Borman and Spring (1984) who argue that educational policies, established by competing self-interests of the public, capitalists, administrators, and teacher unions, are not always in the best interests of the schools or school children. Describing politics at the local level, they maintain that school boards are run by the civic elite, superintendents have little control, and central administrations are bureaucratic and reluctant to facilitate change.

The current model of educational facility planning does not consider the devastating impact of inequities in the system of school financing for poor schools, especially urban districts. Even with massive changes in state involvement in school finance and governance since the 1960s, decision-making and leadership in school building and planning remains a local matter (Walker, 1993). The state has traditionally provided minimal assistance for debt service or building authorities. Even with the increased burden on districts due to age, population growth, and inadequate construction, few states today help equalize the burden.

In a study of decision-making in the planning and design of Illinois public school facilities, Westbrook (1988) found that strategies employed by educational administrators to acquire resources were designed to operate successfully within a tacit, assumptive, policy-making world. This knowledge was used to circumvent an established, highly formalized system, substituting a more operative system for the improved anticipation, planning, and provision of adequate educational facilities.

As a result, educational administrators are often more concerned with securing funds for school facilities than making sure the needs of educational programs are met in the building design. Westbrook (1988) found that the articulation between educational goals, objective needs and facility design was more of a concern for architects than it was for superintendents or principals, who seemed to feel their options are highly constrained in this area, possibly due to limited resources and state bureaucratic structures.

The example from the Puyallup (Washington) School District illustrates the necessity of campaigning for community support when attempting to raise the resources required to implement the facility plan. Puyallup S.D. had twice failed to pass bond issues, but were nevertheless faced with the quandary of looking for solutions to their explosive enrollment growth projections (Berg & Apostle, 1992). The district planned to develop a prototype that would replicate the basic plan of a set of previously successful elementary schools for future elementary school construction. The prototype strategy allowed the school district to reduce planning time, obtain agency approval ahead of time, and demonstrate to the public the district's ability to make prudent use of taxpayer dollars. After two failed bond issues, they created a community partnership, called the Facilities Crisis Task Force, which included representatives from all geographical areas and political groups. In addition, the district set up the Citizen's Committee for Education to collect and disburse campaign funds. As the task force studied the situation, they came to the realization that the crisis was real and urged the district to resubmit and increase the bond issue to twice the original sum. By pure serendipity, a teacher union strike a month before the election became a catalyst for directing community attention to the facilities crisis. Along with a massive marketing campaign utilizing all forms of media, solid school board support, and over 900 volunteers organized and trained to elicit support from their families and friends, voters returned to the polls and voted in favor of the bond issue.

The current planning model accounts only for organizational factors such as the composition of the planning team, determining the goals of the school district and the immediate needs of the school. The model does not explicitly address what is the most critical aspect of the planning process: the preeminent position of fiscal and political issues over programmatic issues.

It is clear from these criticisms that the current educational planning model needs to more comprehensively factor in the political realities of fiscal resource acquisition, reconsider the impact of a truly collaborative process which extends school reforms such as shared decision-making to the educational facility planning process and also integrates all aspects of the facility development process, such as planning, design, and management into one continuously on-going process.

Reconceptualizing the Educational Facility Planning Process

"Despite the general acknowledgment that educational systems are soft, which suggests that interactive models would be more efficient, rational models continue to be the planning processes of choice for many educational planners" (Adams, 1991, p. 5).

The current model of facility planning can be characterized as a rational model in that it assumes the sufficiency and neutrality of objective expert knowledge, is sequential in nature, and that its planning methods have universal applicability requiring only minimal situational adaptation. However, it is clear that educational policy decision-making is decidedly political and consensual, both characteristics of what Adams (1991) calls interactive models: models which do not bow to the demands of objectivity and quantification and are characterized by value, belief, power, collaboration, consensus building, conflict, and negotiation.

The educational facility planning process can be reconceptualized as containing aspects of both rational and interactive models (see Figure 8.2). Due to the highly value driven aspect of "what is a good educational environment," a wide base of support, participation and consensus is required to effectively create a facility which meets as many needs as possible within the community and the school. In addition, obtaining financial resources to realize a building project requires the support of not only the tax paying community, but the local politicians and the state legislators as well. These processes are political and interactive in nature, not rational. However, once the mission and goals of the school district are established, there are a series of linear, rational steps which must be followed in order to realize the actual school building. Within each process--feasibility, planning, programming, design, construction, and on-going facility management--there are interactive and rational aspects. Each aspect must be recognized as such and integrated.

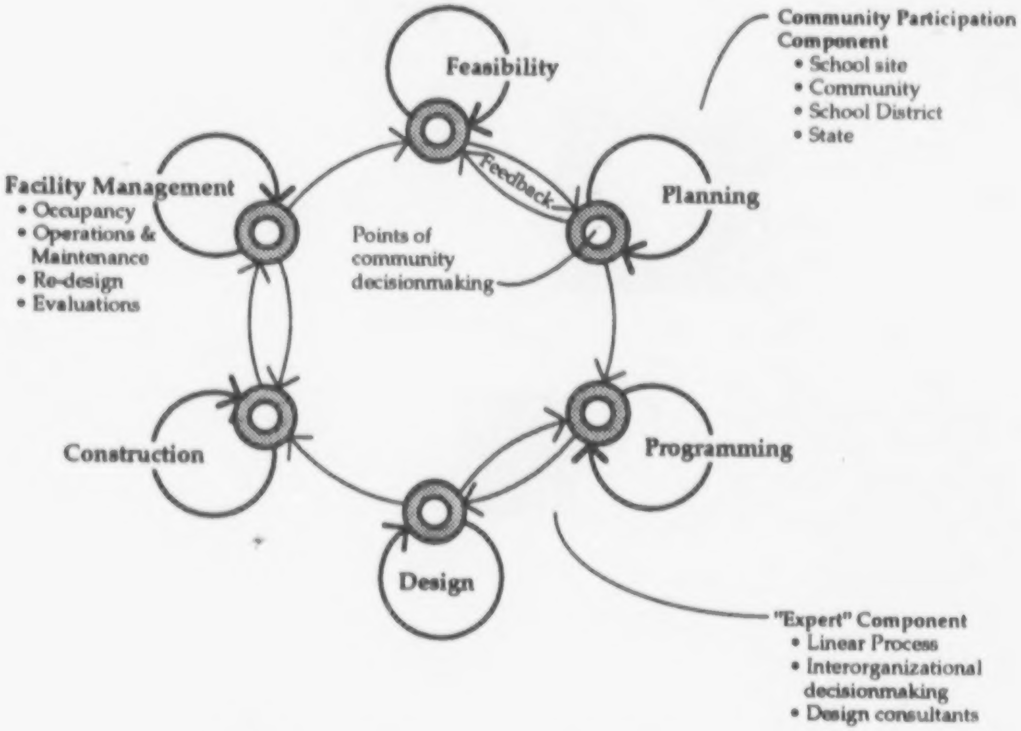
Community Participation Component
• School site
• Community
• School District
• State
Feasibility
Facility Management
• Occupancy
• Operations & Maintenance
• Re-design
• Evaluations
Feedback
Planning
Points of community decisionmaking
Construction
Programming
Design
"Expert" Component
• Linear Process
• Interorganizational decisionmaking
• Design consultants

Figure 8.2 An integrated educational facility development model.

The integrated educational facilities development model emphasizes the equal importance of the feasibility/planning process, the programming/design/construction process and the facility management process (which includes occupancy, operations and maintenance, evaluation and re-design). The model attempts to indicate the need for on-going management of educational facilities to creatively anticipate educational program changes in addition to the traditional repair and maintenance issues. Educational facilities will continue to experience major changes well beyond initial design and construction and this fact must be recognized my school districts nationwide. Decision-making can be opened up at all points in the cycle of facility development.

Conclusions

It is difficult to know how pervasive the use of the current educational facility planning model is across the country, or what the impact of a more integrated model would be. According to the Education Writers' Association study mentioned above, as of 1989, only 12 states had a statewide facilities plan, and 31 states had only an inventory of buildings. Many states had only one staff member assigned to school facilities planning, while only 17 states provided training for school district staff (Walker, 1993). Facilities have been almost completely ignored by state legislatures with less and less of the budget going towards repair and maintenance, let alone new construction. It is clear that more attention must be placed on facilities, given the enormous problems in the school infrastructure.

Faced with the prospects of a growing educational system, and the promise of a continued lack of financial resources to modernize the school infrastructure for the next century, the need to reconceptualize the current model of facility planning will be critical to the success of the planning effort. A more interactive model such as the one presented in the chapter offers to make accessible to a wider audience, the tools to find more creative, reform-minded solutions to the problems of district growth, and to gain the support of the school board, the community, and the taxpaying public.

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